A Conservation Strategy for the Northern Spotted Owl

Report of the
Interagency Scientific Committee To Address the
Conservation of the Northern Spotted Owl

United States Department of Agriculture
Forest Service

United States Department of the Interior
Bureau of Land Management

United States Department of the Interior
Fish and Wildlife Service

United States Department of the Interior
National Park Service

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Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl

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Abbreviations Used In This Report

ASQ	Allowable Sale Quantity
BIA	Bureau of Indian Affairs (USDI)
BLM	Bureau of Land Management (USDI)
CBF	California Board of Forestry
CDF	California Department of Forestry (and Fire Protection)
CDFG	California Department of Fish and Game
CHCP	California Habitat Conservation Plan
CPR	California Parks and Recreation
CRA	California Resources Agency
D.b.h.	Diameter at breast height
EA	Environmental Assessment
EIS	Environmental Impact Statement
FS	Forest Service (USDA)
FSEIS	Final Supplement to the Environmental Impact Statement
FWS	Fish and Wildlife Service (USDI)
FY	Fiscal year
GIS	Geographic information system
HCA	Habitat Conservation Area
HSU	Humboldt State University
MCP	Minimum convex polygon technique
NAS	National Audubon Society
NCASI	National Council on Air and Stream Improvement
NF	National Forest
NPS	National Park Service (USDI)
NWF	National Wildlife Federation
NWR	National Wildlife Refuge
O&C	Oregon and California Railroad Grant Lands (BLM)
OCWRU	Oregon Cooperative Wildlife Research Unit
ODF	Oregon Department of Forestry
OGC	Office of the General Counsel (USDA)
ODFW	Oregon Department of Fish and Wildlife
OSU	Oregon State University
OWIWC	Oregon-Washington Interagency Wildlife Committee
PNW	Pacific Northwest Research Station (FS)
PSW	Pacific Southwest Research Station (FS)
R5	Region 5, Pacific Southwest Region (FS)
R6	Region 6, Pacific Northwest Region (FS)
ROD	Record of Decision

RSA	Random Sample Area
SEIS	Supplemental Environmental Impact Statement
SOHA	Spotted Owl Management Area (BLM)
SOMA	Timber Association of California
TAC	The Nature Conservancy
TNC	University of Idaho
UI	U.S. Department of Agriculture
USDA	U.S. Department of the Interior
USDI	University of Washington
UW	University of Wyoming
UWY	Washington Department of Natural Resources
WDNR	Washington Department of Wildlife
WDW	Washington State Parks and Recreation
WSPR	

Metric Equivalents

1 inch = 2.54 centimeters

1 foot = 0.305 meter

1 square foot = 0.09 square meter

1 acre = 0.405 hectare

1 mile = 1.609 kilometers

1 square mile = 2.59 square kilometers

Contents

Summary

The Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl (hereafter the Committee) was established under the authority of an interagency agreement between the, USDA Forest Service, USDI Bureau of Land Management, USDI Fish and Wildlife Service, and USDI National Park Service. The Committee's charter was signed by the agency heads and subsequently incorporated into Section 318 of Public Law 101-1 21 in October 1989. The Committee was asked to develop a scientifically credible conservation strategy for the northern spotted owl in the United States.

Since that time, the Committee has reviewed the literature on the northern spotted owl, heard presentations from most of the scientists doing research on spotted owls, considered the concerns of numerous interest groups, and conducted field trips in Washington, Oregon, and northern California to examine the owl's habitat. We have also interviewed dozens of biologists and land managers.

Much of the attention directed toward this bird stems from a growing debate over managing old-growth forests on Federal lands, and from a concern about protecting biodiversity. We understand the significance of these larger issues, but we have kept to our mandate to develop a conservation strategy specifically for the northern spotted owl.

We have concluded that the owl is imperiled over significant portions of its range because of continuing losses of habitat from logging and natural disturbances. Current management strategies are inadequate to ensure its viability. Moreover, in some portions of the owl's range, few options for managing habitat remain open, and available alternatives are steadily declining throughout the bird's range. For these reasons, delay in implementing a conservation strategy cannot be justified on the basis of inadequate knowledge.

Owl Habitat and Population Trends

The Committee reviewed all available studies dealing with spotted owl habitat, the relative abundance of owls related to stand age, and the relative abundance of owls in relation to various proportions of successional growth stages in the general landscape.

Habitats selected by northern spotted owls typically exhibit moderate to high canopy closure; a multilayered, multispecies canopy dominated by large overstory trees; a high incidence of large trees with large cavities, broken tops, and other indications of decadence; numerous large snags; heavy accumulations of logs and other woody debris on the forest floor; and considerable open space within and beneath the canopy. These attributes are usually found in old growth, but they are sometimes found in younger forests, especially those that contain remnant large trees or patches of

large trees from earlier stands. In younger forests that support breeding owls, the nest and major roost sites are usually found where large trees from the earlier, older stands remain.

We evaluated the coastal redwood forests of northwestern California, where numerous owls live in stands that are mostly 50 to 80 years old, We believe their presence is attributable to the region's unique set of conditions, including a rapidly growing tree species that sprouts from stumps; intrusion of other conifer and hardwood species into the understory; relatively high rainfall; a long growing season; and abundant prey. Under these conditions, the structural attributes that are usually associated with the presence of owls develop at an accelerated rate. We caution strongly against extrapolating these results to other parts of the owl's range.

Silvicultural prescriptions might be developed that would yield significant volumes of wood products while maintaining suitable habitat for spotted owls, but we find no clear evidence that such prescriptions currently exist. Until they do, the prudent approach to ensuring the viability of the owl is to protect an adequate distribution and amount of existing habitat. Nonetheless, examining younger forests where spotted owls reproduce successfully should yield valuable insights into silvicultural techniques that could produce both wood products and owls.

For at least the past century, loss of spotted owl habitat has exceeded recruitment. By some estimates (perhaps conservative), spotted owl habitat has been reduced by about 60% since 1800. The current total population of the owl is likely to be far less than once existed. The loss of habitat has not been distributed evenly across the range of the subspecies.

Owl habitat is also being fragmented, a process that isolates some populations of owls. Fragmentation in the home ranges of individual birds may expose owls to greater risks of predation and competition. It may also result in habitat loss when trees blow down in high winds, and as stands suffer other impacts associated with forest edges.

Determining the number of northern spotted owls in existence has drawn considerable attention. Current data do not permit a statistically reliable population estimate. The approximately 2000 pairs located during the past 5 years or reconfirmed from pre-1985 surveys represent an unknown fraction of the total population. More significantly, demographic studies from the Klamath Mountains in California and the Coast Range in Oregon indicate that populations in these study areas are declining.

The Conservation Strategy

We propose a two-part conservation strategy. The first stage, prescribes and imple ments the steps needed to protect habitat in amounts and distribution that will adequately ensure the owl's long-term survival. The second stage calls for research and monitoring to test the adequacy of the strategy and to seek ways to produce and sus tam suitable owl habitat in managed forests. Insights gained in this second stage can be used to alter or replace habitat conservation areas prescribed in the first stage, but only if the modified strategy can be clearly demonstrated to provide adequately for the long-term viability of the owl.

Our strategy largely abandons the current and, we believe, flawed system of one- to three-pair spotted owl habitat areas (SOHAs), in favor of protecting larger blocks of habitat—which we term Habitat Conservation Areas, or HCAs.

Large blocks of habitat capable of supporting multiple pairs of owls, and spaced closely enough to facilitate dispersal between blocks, are far more likely to ensure a viable population than the current SOHA system. Owls in an HCA containing multiple pairs will benefit from internal dispersal of juvenile owls as well as recruitment of dispersing birds from other HCAs. Owls in HCAs containing multiple pairs are less vulnerable to random fluctuations in birth and death rates. Large HCAs reduce the impacts of habitat fragmentation and edges, and they are more resistant than SOHAs to small-scale natural disturbances.

The Committee has delineated and mapped a network of HCAs necessary to ensure a viable, well-distributed population of owls. Wherever possible, each HCA contains a minimum of 20 pairs of owls. The maximum distance between these HCAs is 12 miles. Our 20-pair criterion is based on models of population persistence and empirical studies of bird populations. We have chosen 12 miles as the maximum distance between HCAs because this value is within the known dispersal distance of about two-thirds of all radio-marked juveniles studied.

The HCA concept applies primarily to BLM, FS, and NPS lands, as delineated in the enclosed maps. The Committee strongly recommends that HCAs be established on State lands in certain key areas (as shown on the maps) to assure population connectivity. We also recommend that resource managers of other State lands, tribal lands, other Federal lands, and private lands use forestry and silvicultural techniques and practices that maintain or enhance habitat characteristics associated with spotted owls.

In several regions, current habitat conditions and owl densities do not allow us to follow this approach. The Committee has modified the guidelines for these regions. For example, in portions of the Oregon Coast Range, habitat is currently insufficient to fully stock 20-pair HCAs with owls. We have delineated 20-pair HCAs for this area, but they will be not be capable of supporting 20 pairs of owls for many years. In the meantime, individual-pair HCAs are prescribed around all known or future pairs to reach the 20-pair target.

A variety of strategies was used in other areas of special concern to help meet the intent of this strategy. Portions of the Cascade Range of northern Washington contain insufficient habitat capable of supporting 20-pair HCAs over the long term because of inherent landscape patterns. In these areas, we delineated a network of smaller HCAs but shortened the maximum distance between them to 7 miles, to facilitate dispersal.

In portions of the eastern Cascade Range in Washington and Oregon, and northeast of Mount Shasta in California, relatively little owl habitat exists and spotted owls occur at low densities. We prescribe individual-pair HCAs around all known pairs and pairs located in the future.

Spotted owls on the Olympic Peninsula are probably demographically isolated from other populations by more than 60 miles of intensively managed State and private forest lands. We have established a large HCA on National Forest lands, but we also prescribe individual-pair HCAs around all known pairs outside the HCA and recommend smaller HCAs for State lands. Our hope is that connectivity can be restored by using a combination of HCAs and applying innovative silvicultural techniques on State and private lands.

Land ownership patterns in the Coast Range of California limit our ability to establish 20-pair HCAs. We have tried to do so wherever possible, but we encourage California to work with private land owners to apply innovative silvicultural techniques to maintain or develop additional owl habitat for dispersal and breeding. We encourage Oregon and Washington to do the same.

Logging (including salvage operations) and other silvicultural activities (with the exception of stand regeneration) should cease within HCAs. The Committee recognizes that allowances will have to be made for timber sales already planned and under contract in HCAs, such as sales necessary to meet Section 318 of Public Law 101-1 21.

We considered dedicating corridors of forests between HCAs to facilitate dispersal by juvenile owls, but decided corridors were unnecessary, provided at least 50% of the forest landbase outside of HCAs is maintained in stands of timber with an average d.b.h. of 11 inches or greater and at least 40% canopy closure. We also rely on lands currently allocated to such uses as riparian corridors, streamside management zones, and special management areas for pileated woodpeckers and pine martens to provide additional habitat for dispersing spotted owls.

We recommend retaining at least 80 acres of suitable owl habitat around the activity centers of all known pairs of owls in the managed forest, up to a total of seven per township. These centers will serve as older forest nuclei that could become core areas for future breeding pairs of spotted owls as the surrounding forest matures. If healthy populations of northern spotted owls can be sustained in the managed forest, HCAs will no longer be necessary. Timber harvests that affect owl pairs outside the conservation areas are therefore viewed as experiments in managing for spotted owl habitat.

Consequences for the Northern Spotted Owl

The Committee believes this conservation strategy, if faithfully implemented, has a high probability of retaining a viable, well-distributed population of northern spotted owls over the next 100 years. The HCAs on Federal lands contain 925 known pairs of owls, and we estimate the actual number to be about 1465 pairs. Regeneration of younger stands within HCAs on Federal lands should enable the spotted owl population to increase to about 1759 pairs. These numbers are important, but only up to a point; the amount and spacing of habitat are as critical to the viability of the subspecies as the actual numbers.

Under a worst-case scenario, even with this conservation strategy fully implemented, a short-term loss of a significant portion of the existing population of northern spotted owls is likely. We do not take this loss lightly, but we believe the subspecies can withstand a reduction provided our strategy is followed. Even under the most stringent scenarios of habitat protection, a similar reduction in the number of existing pairs over time seems likely because many pairs of owls live in highly fragmented and marginal habitats isolated from other pairs.

Implementing the Conservation Strategy

Implementing a comprehensive strategy for the spotted owl requires a well-coordinated program of research, monitoring, and habitat management by State and Federal agencies and private landowners. Much room for improvement exists. So far as we can determine, for example, no plans have been made within or among agencies to determine what changes in population size or habitat conditions would trigger a review of, and possible changes in management actions needed to ensure the welfare of the owl.

Assessment of Impacts

We urge that a coordinator and interagency staff (State and Federal) be assigned to oversee the conduct of the conservation strategy. The coordinating group would have the additional duty of recommending alterations to our conservation strategy. The plan put together by our Committee, however, is a strategy for the entire U.S. range of the northern spotted owl. No part of the strategy was designed to stand alone, and proposed changes must be considered in that light.

Our assignment was to develop a scientifically credible conservation strategy for the northern spotted owl. We recognize that the impacts of the strategy we propose will be analyzed by others. The immediate response, we expect, will be to focus almost solely on the short-term economic and social impacts of implementing the strategy as it affects the availability of timber. This assessment is critically important. Adoption of the conservation strategy, however, has significant ramifications for other natural resources, including water quality, fisheries, soils, stream flows, wildlife, biodiversity, and outdoor recreation. All of these aspects must be considered when evaluating the conservation strategy. The issue is more complex than spotted owls and timber supply—it always has been.

The Conservation Strategy

Introduction

An Interagency Agreement between the Bureau of Land Management (BLM), the Fish and Wildlife Service (FWS), the Forest Service (FS), and the National Park Service (NPS) provided the authority under which a committee of scientists (hereafter, the Committee) was established to re-evaluate the current management status of the northern spotted owl.[1] The charter commissioning the Committee was signed by the four agency heads on 5 October 1989 (appendix A). This charter, recognized in law in October 1989,2 specifically directed the Committee to develop a scientifically credible conservation strategy for the owl in the United States. It did not charge us with analyzing the effects of the developed strategy on timber supply, other natural resources, or the costs and benefits to other user groups. This task falls to others.

The Committee Charter and the Team

The team that carried out the Charter assignment consisted of a six-member Committee, three advisors from involved States (Washington, Oregon, and California), interest-group advisors (representing the timber industry, environmental groups, and academia), and staff and advisors from the four agencies—BLM, FS, FWS, and NPS (see appendix U for participants and their curriculum vitae). Thirteen of the 16 team members have extensive experience with research or management of the owl, or both. The team, collectively, was thoroughly familiar with the geographic areas under consideration, the owl habitat and distribution within those areas, the literature concerning the owl, and with ongoing research. Five team members are currently conducting research on the species.

The Concern

Why all the fuss about the status and welfare of this particular bird? The numbers, distribution, and welfare of spotted owls are widely believed to be inextricably tied to mature and old-growth forests. Such forests have been significantly reduced since 1850 (mostly since 1950) by clearing for agriculture, urban development, natural events such as fire and windstorms, and most significantly, by logging in recent decades. Nearly all old growth has been removed on private lands. Most of the remainder is under the management of the BLM, FS, and NPS on Federal lands. As its habitat has declined, the owl has virtually disappeared from some areas and its numbers are decreasing in others.

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[1] For convenience, "spotted owl" or "owl" means the northern spotted owl *(Strix occidentalis caurina).* Full common names are used for all other owls, including other subspecies of the spotted owl. Scientific names of all organisms named in this report are given in appendix v, table vi.

[2] Section 318 of Public Law 101-121.

The apparent decline of the spotted owl has attracted the attention of various governing agencies. The State of Washington considers the bird "endangered." Oregon calls it 'threatened." The California Department of Fish and Game (CDFG) identifies it as a species of special concern." The BLM considers it a "special status species" and provides special management. The FWS, after being successfully challenged in court over a recent decision not to list the northern spotted owl, is again considering it for listing as a 'threatened species" under the Endangered Species Act of 1973. The FS, following regulations issued pursuant to the National Forest Management Act of 1976, is responsible for maintaining viable populations of all native and desirabie non-native, vertebrate species, well-distributed within each planning area. This mandate includes the owl, which the FS also considers a "sensitive species" and an "indicator species" for old-growth ecosystems.

Why all these laws and regulations? The evolution of laws dealing with the management of Federal, State, and private forest lands in the United States reflects increasing societal concern for environmental values. What seems to be emerging from this fermenting brew of law and regulations, public interest, and scientific debate is a growing concern with retaining and enhancing what scientists call "biodiversity." Clarity on the concept of biodiversity is only now emerging, but it is an evolving idea in the science and philosophy of biology that seeks precision in, and a means for applying, the common-sense admonition of Aldo Leopold that "...to keep every cog and wheel is the first precaution of intelligent tinkering."[3]

Scientific Credibility

In gathering information to accomplish our Charter assignment to develop a "scientifically credible" conservation strategy for the owl, we realized that not everyone agrees on what assures scientific credibility. With that noted, we chose a path along which all of our steps, the processes by which we reached conclusions, and the data on which those conclusions rested, were fully open and available to anyone who chose to examine them. The open-door policy lasted until we began to prepare the final report during the last month of a 6-month process. A neariy final draft was submitted for peer review by knowledgeable scientists selected by the presidents of five professional societies—the American Ornithologists' Union, the Ecological Society of America, the Society for Conservation Biology, the Society of American Foresters, and The Wildlife Society. This report includes many modifications made in response to the constructive comments of those reviewers.

The Human Factor

Our conservation strategy was not, nor could it be, formulated solely from biological data. Various Federal and State laws and regulations, land ownership patterns, past and present land uses, landscape features, existing habitat conditions, current and anticipated allocation of forested land to various uses, regional and national cultures, and the reality of trade-off s in all land-use decisions also influenced our choices. To pretend that a workable conservation strategy for the owl can be derived and instituted without considering such factors is unrealistic. We did not, however, feel unduly constrained by these realities. Had we concluded that only total cessation of logging in remaining suitable habitat would save the owl, we would have so recommended. Conversely, we were equally prepared to state that the owl needed no protection, if that were indicated.

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3 Leopold, A. 1953. Round River—from the journals of Aldo Leopold. Edited by Lurn' B. Leopold, Oxford University Press, N.Y., p. 147.

Conservation problems cannot be solved through biological information alone, nor from applying "scientific truth." Rather, solution comes from a combination of considerations that satisfy society's interests. A strategy that has any chance of adoption in the short term and any chance of success in the long term must include consideration of human needs and desires. To ignore the human condition in conservation strategies is to fail. We have searched for a way to assure the continuing viability of the owl that still allows continuation of some substantial cutting of mature and old-growth forests. Evaluation of the environmental and economic effects of the strategy we propose, however, was not within our purview. Such evaluation will be done by others more expert in these areas than are we.

How the Findings Are Presented

The strategy is described in some detail in this part of our report, which includes discussion of most of the rationale behind our decisions. In addition, 22 appendices provide what we believe to be sufficient detail for readers to track what we have done and why. Our primary objectives were to develop a strategy to assure the viability of an owl population well-distributed throughout its range in the United States for at least 100 years, and to explain why we believe that strategy will accomplish these goals.

The Spotted Owl and a History of This Issue

The northern spotted owl is widely distributed in forested regions of western Oregon and Washington, and in northwestern California, primarily in mature and old-growth conifer forests. The American Ornithologists' Union (AOU) recognizes three subspecies—northern, California, and Mexican. The AOU, the accepted authority in such matters, recently ruled that this classification will stand in spite of recent genetic findings that raised some questions about validity of the three subspecies (appendix C). The spotted owl is a medium-sized owl with dark eyes, dark brown coloring with whitish spots on the head and neck, and white mottling on the abdomen and breast. Mostly nocturnal, it forages in forests, consuming small mammals such as flying squirrels, mice, and woodrats. During the day, it roosts in trees, frequently close to the nest site.

The Northern Spotted Owl

Pairs tend to occupy the same territories year after year as long as suitable habitat is present. One to three eggs, usually two, are laid in March or April. The female incubates the eggs and broods the young, while the male provides most of the food for the female and young. After leaving the nest in May or June, the young are fed by both parents until August or September. By October, the young become independent and disperse from the parental nest areas. Dispersing young become "floaters" (see appendix 0) and do not typically acquire territories until they are 2 to 3 years of age. Although a pair may occupy and defend a territory, they may not nest every year.

Historical Perspective of Northern Spotted Owl Management

Before the early 1970s, little was known about the spotted owl in Washington, Oregon, or California, except that it resided in a variety of forest types. Early research in Oregon and California indicated an association with mature and old-growth forests.

Interest in uncommon species increased as Federal legislation dealing with endangered species in the late 1960s culminated in passage of the Endangered Species Act of 1973. Interagency management efforts for spotted owls began in 1977, with the development of management guidelines for public lands in Oregon (appendix B). This effort expanded to Washington and California with the development of Forest planning guidelines for spotted owls under the National Forest Management Act.

In response to public concern about habitat loss, the FWS undertook their first status review of the species in 1982. They found that Federal listing of the species as threatened was not warranted then. Responding to appeals challenging Forest planning standards and guidelines, however, the FS undertook a supplemental EIS on spotted owl management guidelines in Oregon and Washington. In California, the FS chose to handle management decisions through their Forest Plans. The BLM, in cooperation with the Oregon Department of Fish and Wildlife (ODFW), established habitat areas for spotted owls at 110 sites in Oregon, pending the completion of new District timber management plans.

Federal, State, and private industry research work expanded greatly in all three States during the mid-1980s in an effort to clarify the relation of the owl to its habitat. As a result of these efforts, concern for the species increased. The State wildlife agencies listed the species in Washington as endangered and in Oregon as threatened. The FWS was petitioned in 1987 to list the owl as threatened, but listing was again considered unwarranted. A court appeal led to rewinding that decision and resulted in another status review. A final decision on listing is due in June 1990.

Continuous litigation by interest groups over the logging of old growth resulted in Section 318 in the FY90 Appropriations Act, passed in October 1989, which provided some additional protection for old growth and existing areas now managed for spotted owls. Our Committee was established at the same time to develop a conservation strategy for the owl.

Methods

We established an agenda, schedule, objectives, operating procedures, and guidelines for deliberations. We then acquired information, examined owl habitat in the field, analyzed and synthesized data, and examined the current management situation. With that information as a foundation, we formulated a map-based conservation strategy, suggested administrative procedures to facilitate its implementation, and described a research and monitoring approach to evaluate the strategy and provide a feedback system for modifying it when and if information indicates such a need.

The Steps

Operating Sideboards

At our initial meeting, we agreed to the following operating procedures and sideboards:

- We will strive diligently for consensus.
- If consensus is impossible to achieve, a minority report will be appropriate. [Note: Consensus was achieved, so a minority report will not be issued.)
- The criteria for a successful conservation strategy will be rooted in the philosophy stated in the regulations pursuant to The National Forest Management Act to maintain viable populations that are well distributed.
- All land ownerships will be considered in the conservation strategy.
- “Hands on” management of habitats and animals will be considered, such as transplanting of owls, enrichment of gene pools, silviculture, and so on.

- The effects of timber sale programs being carried forward under the Hatfield-Adams Amendment will be considered in deriving the conservation strategy.

- Although the spotted owl issue is, to some degree, a surrogate for the old-growth issue—that is, on how much old-growth shall be preserved, where, and in what form—we will focus strictly on questions of spotted owl population viability across its occupied range.

- The best management for the northern spotted owl obviously is to preserve all stands of mature and old-growth timber within the range of the bird and to grow more such stands as soon as possible. Recognizing the real-world situation, however, we will consider a less than optimal approach to spotted owl habitat management that will, to the extent possible, simultaneously provide a high probability of population viability for the northern spotted owl, well-distributed within its range, and still allow the cutting of old-growth and mature timber. The Committee, however, considers as its primary mission (from the Charter) the mandate to "develop a scientifically credible conservation strategy for the northern spotted owl."

Sources of Information

We arranged expert presentations covering topics pertaining to conservation of the owl, (appendix E), and acquired and reviewed the relevant literature. We used information from all sources we considered appropriate, including refereed literature; reports from agencies, organizations, legal firms, and corporations; theses; unpublished data; draft manuscripts; and other sources. Data from this array of sources were extracted, tabulated, and summarized by topic. Most persons who are currently doing research and monitoring on owls presented their information to us. All information collected will be archived at FS Region 6, Portland, Oregon.

Field Tours

We agreed that all members of the team must have first-hand knowledge of owl habitat, management opportunities, and constraints in all portions of the subspecies' range. Accordingly, we spent 11 days touring and hiking through spotted owl habitat, visiting nest and roost sites, and discussing local situations with field biologists at each site visited in the various physiographic provinces in Washington, Oregon, and California (appendix E). This travel included visits to owl sites in a variety of forest age-classes ranging from young to old growth.

Data Synthesis

The Committee and staff summarized and synthesized data and other information derived from the sources noted above. These analyses, presented in appendices to this report, were the basis for developing and testing alternative, map-based conservation strategies, and ultimately selecting the strategy proposed here. Full understanding of how we reached key decisions cannot be attained without careful, detailed study of certain key appendices (especially C, F, I, and K through T).

Workshops

We sponsored three workshops to acquire insights and advice from experts (appendix E). Twenty-six wildlife biologists experienced in owl management from the BLM, FS, and FWS met with us for 3 days. These biologists appraised geographically specific constraints and opportunities, reviewed several proposed alternatives for a strategy, and provided us with insights and judgments based on their collective knowledge and experience. We held two additional 3-day working sessions with many of these same biologists, during which they reviewed maps displaying layouts of blocks of habitat for the owl. They suggested some adjustments based on their intimate knowledge of the areas and owl distributions. Most of these biologists continued to provide consultation as our effort proceeded.

A 2-day workshop explored possible silvicultural alternatives to enhance owl habitat, and examined the potential of those alternatives for owl management. Participants included widely recognized silviculturists, landscape ecologists, forest ecologists, and foresters. A group of five silviculturists also was convened to assist us in preparing a report outlining potential silvicultural options (appendix S).

Our final workshop assembled experts in conservation biology and landscape ecology who, for 2 days, critiqued the evolving conservation strategy for spotted owls in light of their experience with other species and their knowledge of applicable theory (appendix E).

Management Review of Ongoing FS and BLM Management

Consistent, high-quality management for spotted owls is critical to the successful implementation of any conservation strategy. We evaluated the quality and consistency of current management by interviewing FS and BLM managers and technical specialists in timber management and wildlife biology (appendix D).

Information Support for a Conservation Strategy

We then considered whether available information sufficiently warrants instituting a conservation strategy, given its obvious economic and social impacts. Variability exists in all biological data, and answers to some important questions will probably always be uncertain, but the knowledge about spotted owls is extensive and impressive. We believe the basic message emerging from the sum of that knowledge, particularly about trends in the amount of suitable habitat and the numbers of owls, justifies a conservation strategy. In some areas of the owl's range, few habitat options remain and those are disappearing rapidly. If our true objective is to assure a viable population of spotted owls, widely distributed throughout their current range, then delay in instituting an adequate conservation strategy for the owl cannot be justified because of inadequate knowledge or understanding.

Maps

The process of formulating a strategy next turned to maps. Maps provided us with visual information about the geographic distribution of the owl and suitable owl habitat, current locations of owls, and areas reserved from timber harvest—Wilderness Areas, National Parks, currently designated owl-management areas, Research Natural Areas, riparian and visual corridors, and so on.

Physiographic Provinces

Because the owl's range is so extensive, we subdivided it into smaller areas for practical and analytical purposes. Demographic studies of owls have revealed variations in numbers, distribution, and habitat-use patterns by forest zones (for example, western hemlock versus mixed-conifer). "Physiographic provinces" provide a recognized set of landscapes by which we have subdivided the range (fig. C2, appendix C).

Developing Standards and Guidelines

From literature reviews and consultation with specialists in ecology and conservation biology, we reached a general agreement on basic concepts that should guide conservation planning for numerous species, including the spotted owl. Based on these concepts, we then developed standards and guidelines (appendix O) for generating a map-based strategy. Working in teams for each geographic province or State, the Committee and agency biologists delineated proposed habitat blocks on acetate map overlays. Decisions on the number, size, shape, and location of the blocks were based on the current and potential distribution of suitable owl habitat, the current distribution and densities of owls, existing land ownerships, owl home-range and habitat use, owl dispersal capabilities, current and potential "bottleneck" areas that might isolate subpopulations of owls, and general ecological principles of conservation biology.

Mapping the Strategy

A map was created to represent a unique "solution" with a specific distribution of habitat blocks of various sizes. This map was then evaluated, to the extent possible, by applying both personal judgment (using site-specific knowledge) and quantitative evaluation of specific components of the standards and guidelines (see appendix O). Any conclusions drawn from these tests that failed to confirm specific properties of the map (for example, the size or location of management areas) were used to redraw and refine the map. The new map was then similarly tested until a solution was reached that met all criteria specified in the standards and guidelines. We drafted and tested maps for at least 10 iterations using this method. Each iteration was drafted, tested, and adjusted until all map properties were confirmed or explained and the process was considered final.

Descriptions of the management situation in each geographic province occupied by the owl supplemented the map (appendices C and O). These descriptions focused on problems and opportunities unique to owls in each area, based on current and anticipated future availability of suitable habitat, considering land ownership, site characteristics, distribution of owls, and management options. The values and rationale used to establish the size of each block were habitat descriptions (appendices F, G, and H), home-range sizes and characteristics (appendix I), and population persistence related to population size (appendices M and O). Spacing between blocks and the nature of the "connecting" habitat needed to facilitate dispersal of birds from one block to another, were established as described in appendix P.

The Current Situation

Distribution

The present range of the spotted owl includes most of its historic range (fig. C1, appendix C), encompassing an area from southwestern British Columbia, southward through the Coast and Cascade Ranges (both west and east sides) of Washington and Oregon, and into southwestern Oregon and northwestern California, north of San Francisco. Although the owl still occupies much of its historic range, its distribution within that range has decreased. For example, spotted owls probably once resided in forested areas of the Puget Trough in Washington and adjacent to the Willamette Valley in Oregon, but those areas have largely been harvested or converted to agricultural and urban uses. Similar but less complete habitat changes appear to have negatively affected owl distribution and abundance in southwestern Washington and northwestern Oregon, where pervasive timber harvest and wildfires have eliminated most older forests.

Areas of Special Concern

Lands throughout the owl's range differ in quantity and quality of forested habitat. Ownership patterns result in an array of land treatments with various effects on owl habitat. Wildfires, windstorms, and volcanic eruptions have played a major role in shaping conditions in owl habitats today. We identified "areas of special concern" in physiographic provinces where past fires, windstorms, timber cutting, and conversion of forest land to other uses have had greater impacts on owl habitat than elsewhere. Special management for owls is required in these more impacted areas.

The Situation by Land Ownership

FS lands—About 74% of the 7.1 million acres of owl habitat estimated to exist in 1989 occurred within 17 National Forests that are managed for multiple uses. Forest Service managers must assure the continued existence of spotted owls, well-distributed throughout their range, while at the same time meeting other resource requirements, including timber sale targets. Logging is currently the main cause of decline in suitable habitat for the owl. Harvest rates on National Forests indicate that logging will proceed at the rate of about 71,000 acres of suitable owl habitat per year, if present trends continue. If the FS preferred-alternative plans for Forests with spotted owls are implemented, the acreages of suitable habitat harvested per year will decline by 25 to 30%, even without adoption of our proposed conservation strategy.

The Endangered Species Act of 1973 was probably the catalyst that triggered FS interest in the welfare of the northern spotted owl. That interest intensified with selection of the owl as an "indicator species" for dwindling old-growth ecosystems. As a result, the FS implemented a plan to provide a network of habitat areas to be managed for spotted owls.

Each habitat area established under the FS plan was designed to support one to three pairs of owls through time and intended to assure continued existence of the bird over the long term. To date, 654 of these management areas have been delineated. Standards and guidelines, used to establish the management areas, prescribed significantly less suitable habitat than both the mean and median amount found to occur in home ranges of owl pairs (appendix I), and 161 (25%) of the management areas contain less than the amount of habitat prescribed in the guidelines.

BLM lands—The BLM controls about 12% of the remaining habitat suitable for northern spotted owls. Most of these lands are in Oregon. The current policy for managing these lands, most of which occur in a "checkerboard" pattern of alternating sections (1 square mile, or 640 acres) of private and public ownership, specifies that timberlands shall be managed under sustained-yield principles to provide a permanent source of timber supply, watershed protection, streamflow regulation, and recreational opportunities.

A policy statement of 16 March 1983, from the Director of the BLM, interpreted the Oregon and California Railroad Grant Lands Act of 1937 as allowing consideration of Oregon's goals and objectives for State-listed "threatened or endangered" species. The policy specified that timber harvest could be restricted through land-use planning to achieve habitat objectives for such species. In response, the BLM provided some habitat through land-use plans and also established 110 interim management areas in agreement with the ODFW, until land-use plans are completed in 1992. In California, BLM lands are managed under the Federal Land Policy and Management Act of 1976, which calls for multiple use, including consideration for wildlife.

NPS lands-About 8% of existing suitable owl habitat is found within eight National Park areas in Washington, Oregon, and California. These parks have not been thoroughly or systematically surveyed. About 110 owl pairs are anticipated, based on the total amount of suitable habitat in these areas. Olympic National Park probably contains habitat for 60 to 80 pairs. Populations in other NPS areas range from 1 to 20 pairs. Management objectives for National Parks are generally considered to be compatible with providing habitat for spotted owls.

Indian lands—Tribal lands of the Quinault, Makah, Yakima, Confederated Warm Springs, Confederated Grande Ronde, Siletz, Hoopa, and Round Valley Indian Nations contain significant acreages of forest, most managed for timber production, with most already logged. The amounts of suitable owl habitat are not known precisely and inventories for owls have not been done on most tribal lands. Some Indian Nations presently have some lands reserved from timber harvest; these lands may contain several pairs of owls. The long-term occupancy of those sites probably depends on their proximity to FS and BLM lands with suitable owl habitat.

FWS lands—The FWS administers several National Wildlife Refuges within the range of the owl. Two refuges in Oregon and two in Washington contain small parcels of suitable owl habitat.

State lands-A small percentage of the existing suitable habitat occurs on lands owned by the States, although extensive forested areas exist that could, in time, produce suitable owl habitat. These lands are administered by several agencies within State governments and can be grouped into three categories—parks, forests, and wildlife lands.

State parks with owls range from a few hundred to about 50,000 acres. Because parcel size tends to be small, owl occupancy is strongly influenced by the condition of surrounding forested lands. Management objectives are generally compatible with maintaining owl habitat. No timber harvest is scheduled, but salvage operations often remove trees that have blown down or are a hazard to recreationists.

Areas of forested lands administered by State wildlife agencies are extremely limited. The Washington Department of Wildlife (WDW) has three areas of 25,000 to 50,000 acres that do not now contain suitable owl habitat. Forests on those lands could develop into suitable habitat, however, and WDW policy calls for more than 50% of the landbase in these areas to be managed to attain old-growth characteristics. The ODFW has two parcels primarily covered with younger forests. Owl occurrence is unknown on those areas, but surveys are planned for summer 1990. Eel Lake, a small parcel, has a timber-management plan for logging 80% of the area over 30 years. No logging is planned on the other parcel until a forest-management plan is completed in 1990.

State forests are managed primarily for timber production. The States own extensive forests, but because of past logging and fires, only small amounts of older stands now remain. Rotation schedules currently average 70 to 80 years. Whether suitable owl habitat will develop in the latter part of such rotations depends on site productivity, climate, residual older trees, and dead woody material on the ground. Plans dictate cutting most of the remaining older stands of forest during the next 10 to 30 years, although some areas have been reserved from timber cutting, generally in scattered parcels or corridors.

Forest Policy Acts of each State differ in requirements for streamside corridors or other areas reserved from timber harvest that might provide habitat for owls. The Washington Department of Natural Resources (WDNR) has deferred harvest until the year 2005 on a 15,000-acre block of older forest near the Olympic National Park and the Olympic National Forest. The California Department of Forestry (CDF) currently has no owl-management plan but is leading an effort to prepare one for the State that will address conservation of owl habitat on private and State lands. One State Forest (Jackson) has significant potential to contribute to the welfare of spotted owls in California, but changes in present practices would be required.

Forest management operations on State and private lands in Oregon are governed by rules promulgated under the Oregon Forest Practices Act. The Act, amended in 1987, requires the Board of Forestry to adopt rules protecting State-listed wildlife species and nesting sites of "sensitive" bird species. Interim rules require a written plan to be approved by the State Forester when any forest operation will occur within 300 feet of the nesting or roosting site of a species listed as either sensitive, threatened, or endangered. Until final rules are adopted in 1991, protection is handled case by case.

Habitat

Evaluation of Habitat Suitability

Private lands-The two major categories of private land include "timber industry" lands (usually large companies), and lands owned by individuals. Most timber industry lands are intensively managed to produce wood. In northwestern California in 1989, owls were reported from 282 sites (99 pairs were verified) on private lands. Because most private lands in California will undergo timber harvest at economically opportune times, the quantity and distribution of owl habitat there will vary. The specifics of such variation, including possible effects on owls, are unknown.

Amounts of suitable habitat and numbers of owls on timber-industry lands in Oregon and Washington are largely unknown. Most forests are managed on rotation ages of 70 years or less, with some on 40-year rotations. Clearcutting is the primary silvicultural prescription for harvest and regeneration. Fewer than 30 occurrences of owls have been documented on private lands in these two States. Additional surveys are needed on private lands in these areas to determine whether owls are as uncommon there as current data indicate.

In summary, the large number of State and Federal agencies and entities managing lands with owl habitat, and their varied land-use objectives, produce circumstances not conducive to a comprehensive, biologically based, consistent management strategy. Even between subunits of the same agency, regulations and management directives are often applied differently.

The Current Management Strategy for Spotted Owls

Current management of FS lands in Washington, Oregon, and California and of BLM lands in Oregon includes establishing a network of spotted owl habitat areas that are reserved from logging and are intended to provide enough suitable owl habitat to support one to three pairs of owls. These areas are called SOHAs by the FS and BLM-ODFW Agreement Areas by the BLM; hereafter, we refer to them all as SOHAs.

A circle approximating the annual home range of a pair of spotted owls was used to bound areas within which SOHAs on FS lands were delineated. These circles ranged from 1.5 to 2.1 miles in radius, and amounts of prescribed suitable habitat ranged from 1000 to 3000 acres, depending on physiographic province. These value ranges were based on observed differences in home-range sizes and amounts of suitable habitat used by radio-marked birds in different physiographic provinces. Acreages of suitable habitat are prescribed well below the mean and median amounts used by radio-marked spotted owls (see appendix I). In some areas, SOHAs are clumped into groups of three. Distances between edges of such clumps or clusters can be up to 14 miles. A maximum spacing up to 7 miles, edge-to-edge, is prescribed between single-pair SOHAs.

The actual SOHAs consist of a set of forest stands, within the circle and identified as suitable owl habitat areas and are reserved from logging. The original circle within which these stands were identified is not, itself, the SOHA boundary. Because of past logging and fire history, SOHA habitat is seldom contiguous. The SOHAs, therefore, are most often irregular in shape, with younger patches of unsuitable habitat interspersed among the stands of suitable habitat comprising the SOHA. The result is fragmentation of suitable owl habitat at the landscape scale (the SOHA network) and at the SOHA scale.

Forest fragmentation appears to have a deleterious effect on the quality of owl habitat, but full understanding is lacking (appendices N and O). The creation of abrupt edges by clearcutting makes the remaining stands more vulnerable to blowing down in windstorms. Fragmentation continues to get worse because forest stands within the circle, but not designated as part of the SOHA, are subject to logging. Whatever suitable owl habitat exists between reserved stands that comprise the SOHA will likely be logged, further fragmenting the SOHA from within.

Methods used to delineate SOHAs differ between FS Region 6 (Washington and Oregon) and Region 5 (California). The SOHAs were not allowed to overlap in Oregon or Washington, but a 25% overlap between SOHAs was allowed in California. No "reserve" habitat to replace stands in SOHAs lost to natural disturbance was provided in Oregon or Washington, but some younger stands were so identified in California.

The BLM SOHA goal was to reserve at least 2200 acres of conifer forest >80 years old within 3 miles of owl activity centers. Because suitable owl habitat is usually found in mature and old growth, stands between 80 and 100 years old are better regarded as marginal habitat. No restrictions on logging apply to private lands that occur within SOHAs designated by BLM, and nearly all private lands in this area of checkerboard ownership have already been logged, usually by clearcutting. Some are being logged for a second time. Thus, on a landscape scale, forest conditions described as suitable habitat for spotted owls are already severely fragmented into older and much younger forests. As a result of the checkerboard ownership and the fact that timber on private lands is managed almost exclusively for economic reasons, little or no opportunity presently exists to change the fragmentation that results. The BLM considers their SOHAs to be "interim" until their next generation of Resource Management Plans are completed in 1992. With minor exceptions, logging within these areas on BLM lands has been deferred until then.

Review of Current Management

Team members interviewed line officers, timber staff, and wildlife biologists from National Forests and BLM Districts and from FS Districts and BLM Resource Management Areas on nine randomly selected Forests in Oregon, Washington, and California, and from three BLM Districts in Oregon. Our objective was to evaluate the implementation of current management guidelines and policies for spotted owls.

Major findings from this effort revealed several problems (see appendix D). Respondents recognized a significant and perhaps irreconcilable conflict between providing required amounts of habitat for spotted owls, and meeting current and anticipated amounts of timber harvest. Several line officers in both the FS and BLM perceive increasing the time and money spent on spotted owl management as usurping resources needed for other programs, especially those aimed at other species of wildlife. Habitat throughout the range of the spotted owl is managed by many agencies and land owners with differing land-use objectives.

The BLM and FS have implemented management plans requiring delineation of SOHAs to be protected for owls, but little consistency exists between agencies. Differences exist even between administrative units of the same agency (see appendix D). The result has been a lack of consistent, comprehensive management planning based on the biological requirements of spotted owls. Inventory efforts differ widely in intensity and technique. Data from inventories between agencies are sometimes not compatible. Consequently, much confusion exists and opportunities that would increase biological understanding of spotted owls have been lost. Credibility of the agencies has also suffered.

We believe that the current situation—that is, the lack of a well-coordinated, biologically based management plan applied consistently throughout the range of the spotted owl—is unacceptable and has contributed to a high risk that spotted owls will be extirpated from significant portions of their range.

We summarized studies about owl habitat (appendix F), and the relative abundance of owls in relation to stand age (appendix G) and to the proportion of the general landscape in suitable habitat (appendix H). Appendix F provides details on the structural attributes of stands judged to be suitable or superior habitat for spotted owls. We stress here that less emphasis should be placed on the **ages** of forests in determining their suitability as owl habitat; instead, emphasis should be on **vegetational** and **structural attributes** that comprise good owl habitat. For our evaluation of habitat suitability, we examined the types of forest that were consistently selected for foraging and roosting by radio-marked owls. We consider these stands to be suitable to superior habitat (appendix F).

Most studies of habitat use (appendix F) indicate that superior habitats for owls in Washington, Oregon, and northwestern California have moderate to high canopy closure (60 to 80%); a multilayered, multispecies canopy dominated by large (>30 inches in d.b.h.) overstory trees; a high incidence of large trees with various deformities (for example, large cavities, broken tops, dwarfmistletoe infections, and other indications of decadence); numerous large snags (standing dead trees); large accumulations of fallen trees and other woody debris on the ground (appendix F); and considerable open space through which owls can fly within and beneath the canopy.

Habitat in Young Forests

The attributes of superior owl habitat, found most commonly in old-growth forests or mixed stands of old-growth and mature trees, usually do not become prominent until stands are 150 to 200 years old. Such features are sometimes found in younger forests, and especially in those that include significant remnants of earlier stands that were influenced by fire, windstorms, inefficient logging, or high-grading (removing the most valuable trees and leaving the remainder uncut). We have seen sites throughout the owl's range where these events resulted in old-growth inclusions in relatively young forests (60+ years) that now support breeding owls. But, with few exceptions, the nest and major roost sites are found where elements of the earlier, older stands remain.

An interesting exception to the usual time needed for a forest to develop from bare ground into suitable owl habitat occurs in the coastal redwood forests of northwestern California, where owls occur in relatively high numbers in stands 50 to 80 years old. This exception is likely attributable to a unique set of conditions: a rapidly growing tree species (redwood) with stump-sprouting capability; early intrusion of other conifers and several hardwoods into the understory; relatively high rainfall; a long growing season; and an abundance of dusky-footed woodrats and brush rabbits as prey (appendices F, G, and J). Under these conditions, structural attributes needed to support occurrence and breeding of owls apparently develop at an accelerated rate, with suitable conditions for owls occurring in 40 to 60 years on some sites and superior conditions in 80 to 100 years. Because these unique conditions occur only in about 7% of the owl's range, we strongly caution against assuming that they will occur elsewhere. Additional studies are needed for a better assessment.

Trends in Habitat and Owl Numbers

Habitat

Habitat for the owl has been declining since the mid-i 800s, when European settlers arrived, although the extent of suitable owl habitat before the 1800s is difficult to quantify. Estimates of 17.5 million acres in 1800 and about 7.1 million acres remaining today indicate a reduction of about 60% (appendix C). This figure may, however, underestimate the full extent of the decline, based on recent inventory data collected by environmental groups. Most of this reduction occurred in the last 50 years. The exact degree of reduction would be interesting to know but not very useful. Undoubtedly, a significant reduction has occurred in owl habitat, and that reduction continues at a rangewide rate of 1 to 2% per year (appendix C).

Population Densities and Numbers of Owls

Piecemeal inventory and monitoring of owls has occurred throughout the range since the early 1970s. Not until the mid-1980s, however, have these efforts been extensive enough to begin providing reasonably good information about the distribution and abundance of owls throughout their range. These results indicate about 2000 pairs located during the last 5 years, representing some unknown fraction of the true number of pairs. Because a census of the total population is not available, we have no statistically reliable population estimate. Recent claims of actual counts of some 6000 birds in 1989 are not out of line with other information from monitoring and inventory efforts.

Population densities of owls are lowest in the northern portion of the species' range, with fewer than 20 pairs known from recent, extensive surveys in British Columbia. The extent of the historic range in British Columbia leads us to believe that original populations were likely many times greater than the current population. Most of British Columbia within the owl's historic range has been logged, and, as a result, little mature and old-growth forest remains.

A small, demographically isolated population of about 100 to 150 pairs (only 88 pairs are actually known at this time) of owls is located on the Olympic Peninsula, in and around Olympic National Park. Fewer than 40 individual owls have been located in recent surveys in the Coast Ranges of southwestern Washington and northwestern Oregon, north of Corvallis. The population also decreases from the Mendocino National Forest south to Point Reyes, California, and from the Klamath Province east to the contact zone with the California subspecies in the Sierra Nevada.

Demography

Results from two study areas where owl demographics were examined—the Klamath Province in California and Roseburg BLM lands in Oregon—suggested that owl populations in both areas were declining during the study period (see appendix U). The most ready explanation for this decline is the loss of suitable habitat. Loss of habitat area, however, only partially accounts for the magnitude of the decline. The spatial arrangement of the remaining habitat must also be considered. Widely dispersed habitat blocks may be unoccupied because of the low probability of successful dispersal to such patches. We caution that the results of these studies cannot be safely extrapolated into future population changes or to the population of spotted owls as a whole.

In both areas, the population growth rate was most sensitive to changes in the adult survival rate, distantly followed by the survival rate of 1st-year birds and fecundity. Two sources of information are relevant to the rate of change of a population. The first is the mathematical sensitivity of the rate of change in a population from one year to the next resulting from variation in the birth and death (vital) rates. The other concerns vital rates that are naturally the most variable (such as 1st-year survival). A population's growth rate may be more affected by a vital rate that changes dramatically from year to year than by one to which it is more sensitive in a mathematical sense. Preliminary estimates of the magnitude of natural variation of vital rates from the Klamath Province of California show little variation in adult survival, but substantial annual variation in the survival of 1st-year birds.

Results of these analyses give us reason to argue strongly that estimates of population parameters (for example, birth and death rates, population turnover) should be used to infer the rate and direction of population change, instead of the counts of individuals and pairs now being used from the FS monitoring program. For example, a long-lived species experiencing a rapid decline in habitat may exhibit increased density from packing (crowding) into remaining habitat by individuals displaced from elsewhere. The disquieting aspect of this phenomenon is the fact that population densities in a given study area may be increasing at a time when the population is not reproducing at a rate sufficient to maintain itself (see appendices U, N, and O). This phenomenon tends to render useless any measures of density as indicators of the general "health" of a population.

Displaced birds may remain nonterritorial and nonbreeding after packing into remaining suitable habitat (that is, they join the floater population-see appendix O), and they may also lower the breeding success and survival rates of territorial birds. These effects result because excess birds, even nonbreeders, may reduce prey availability for territorial birds. A similar effect is believed to have a significant negative impact on survival rates of subadult birds, which are less experienced than adults and tend to be lower in social status. Consequently, any increased competition for prey should have a greater impact on these inexperienced birds.

Conclusions From Modeling

We drew inferences from two simulation models with different structure. The first was developed to crudely approximate the current management design—SOHAs for one to three pairs of owls, dispersed across the landscape with distances between them of 6 to 12 miles. In this model, we varied several parameters, including the distance between SOHAs, dispersal capabilities of adult and young owls, percentage of the landscape that was suitable owl habitat, and different rates of habitat loss from logging. Our purpose was to explore general system properties in an attempt to identify aspects of the owl's life history and behavior that most influence its long-term population dynamics.

In a second model that considered only females, we allowed territories occupied by females (assuming that they were members of pairs) to be adjacent to each other in clusters of 5 to 25 pairs. The primary goal of this effort was to investigate the advantages of relatively large clusters of territories compared to the single- and small-cluster pattern of the current SOHA network. In this model, we assumed that successful dispersal within the natal cluster was more likely than dispersal between clusters. It also seems a logical assumption that the general forest landscape is less hospitable for dispersing birds than the comparatively unfragmented landscape where habitat is aggregated into blocks large enough to support multiple pairs.

We believe that three major conclusions can be drawn from these modeling efforts. First, two rather sharp thresholds exist, either of which can lead to the ultimate extinction of the population. One results from the loss of habitat. As habitat is reduced to small, isolated patches, a dispersing bird's ability to find a suitable territory becomes increasingly difficult and, finally, impossible. The other threshold results from total numbers dropping so low that the probability of finding a mate drops below that required to maintain a stable population. Both results indicate that a species can be severely habitat-limited, even in the presence of suitable but unoccupied habitat.

Second, modeling a dynamically changing system critically affects the analysis and results. The packing of owls into remaining suitable habitat, as a consequence of habitat loss, is likely to produce higher than normal occupancy rates in the short term, and much higher rates than expected under long-term equilibrium conditions. As a result, we recommend care when drawing inferences about long-term abundance from measures of short-term occupancy.

Third, our cluster-model suggests that providing for clusters of pair territories increases the likelihood of owl persistence, primarily by enhancing the successful dispersal of juvenile birds and allowing for rapid replacement of territorial birds that die. Stable population numbers and high rates of territorial occupancy, however, were not observed until clusters contained at least 15 to 20 adjacent territories.

Habitat Fragmentation

Most timber harvest in western Washington, western Oregon, and northwestern California is in patch clearcuts of about 40 acres. This harvest pattern results in both habitat loss and fragmentation. How much of the decline in habitat suitability for owls results from direct loss of habitat and how much, if any, from fragmentation is difficult to discern. Nevertheless, habitat fragmentation may present additional risks for owls, including hypothesized deleterious effects of increased edge between clearcut areas and remaining habitat, and increased risk of predation on adults and young. Fragmentation may also increase the potential for spotted owl displacement by barred owls and great horned owls, the potential loss of microhabitats that lessen effects of weather and provide habitat for prey species, and the potential loss of habitat providing refugia during catastrophic events.

These hypothesized effects of habitat fragmentation on the persistence of the owl may be partially lessened by conservation planning. A strategy that attempts to provide the owl with habitat distributed across the landscape, in a fashion most similar to the historical configuration in which the owl evolved, should provide the best hedge against future extinction. Although that historical configuration cannot be precisely described, it can be surmised with some confidence. An examination of remaining pristine tracts of forest and of aerial photographs taken in the 1950s and 1960s before extensive logging took place, reveals that forests of the past were much more extensive and contiguous than the managed forests of today.

We conclude that the persistence of the owl is imperiled in significant portions of its range by continued loss and concomitant fragmentation of its habitat. This loss has included much habitat that was likely to have been superior for the owl, especially at lower elevations. Loss of superior habitat has led to the fractioning of a formerly more continuous population into smaller, more isolated demographic units. Many of these units are at risk of local extinction because of demographic factors and environmental phenomena.

The Conservation Strategy for the Northern Spotted Owl

The conservation strategy described here was built on a foundation of five concepts of reserve design that are widely accepted among specialists in the fields of ecology and conservation biology (see appendices N, O, and P):

Basic Concepts

- Species that are well distributed across their range are less prone to extinction than species confined to small portions of their range.
- Large blocks of habitat, containing multiple pairs of the species in question, are superior to small blocks of habitat with only one to a few pairs.
- Blocks of habitat that are close together are better than blocks far apart.
- Habitat that occurs in less fragmented (that is, contiguous) blocks is better than habitat that is more fragmented.
- Habitats between blocks function better to allow owls to move (disperse) through them the more nearly they resemble suitable habitat for the species in question (that is, blocks that are well connected in terms of habitat are better than blocks that are not).

Habitat Conservation Areas

Our acceptance of these concepts as the foundation for the conservation strategy led us to propose the establishment of an array of habitat blocks containing multiple pairs of owls. These blocks should be well distributed throughout the range of the owl and spaced closely enough to facilitate dispersal of owls among them. In our conservation strategy, we refer to all blocks of habitat designated for owl conservation as Habitat Conservation Areas (HCAs). These areas can vary from being large enough to contain only one pair when better alternatives do not exist (appendix Q) to a size that now contains, or will become capable of containing, over 50 pairs. In fact, some HCAs in our proposed strategy are not known to contain owls now. Some are small blocks of habitat in strategic locations that could become core areas for pairs if the surrounding habitat in the forest matrix is managed appropriately. Targets for HCA sizes and spacing between them are described

below. The conservation strategy is depicted on enclosed maps and spelled out in detail in the standards and guidelines (appendix Q). Although we briefly indicate certain features of the strategy here, they are necessarily abbreviated. All questions concerning implementation of the strategy should rely solely on appendix Q.

Setting the Size of HCAs

Inferences from the literature—Empirical data guided us to an HCA size large enough to support some multiple number of owl pairs, but not to a certain "best" number. Existing quantitative studies concern species other than the spotted owl, and most only approximate the geographic and landscape situations we face in designing a strategy. Studies that bear on this question, however, suggest that an HCA with 15 to 20 pairs has a moderate to high likelihood of persistence for at least 50 years and a moderate likelihood of persistence for 100 years, even with relatively little or no movement of individuals between HCAs (appendix O). For example, the Channel Islands of California are 32 to 157 miles from the mainland. Extinction rates of bird populations there suggest that initial populations of about 20 pairs have about an 85% chance of persisting for about 100 years. "Rescue effects" by immigrants making the trek over water from the mainland, however, must be relatively small in the Channel Islands example. On the other hand, examples from some British Islands that are considerably closer to the mainland indicate considerably higher persistence likelihoods for populations of 15 to 20 pairs (appendix O). We believe this difference is because the rescue effects of mainland immigrants entering the Island populations occur rather frequently across the moderate water gaps separating the British islands from the mainland. The dynamics of dispersal by spotted owls in forested landscapes more closely approximate the British Island situation.

Inferences from modeling—Attributes of clusters of territories, in terms of expected persistence with various numbers of owl pairs, were examined through modeling (appendix M). Similar to other such efforts, our results suggest that clusters of pairs (as compared to single pairs) will increase the likelihood of owl persistence, primarily by facilitating dispersal of juveniles. Estimating a critical cluster size is most difficult. With the structure of our model, clusters equal to or greater than 15 pairs appeared stable if all sites were initially suitable, and if intervening habitat allowed at least moderate dispersal between clusters (see appendix P). Under more realistic conditions in which HCAs would not initially be a continuous habitat, stability seemed to require at least 20-pair clusters and low to moderate connectivity between HCAs. Individual owls that are members of a large-cluster population are less susceptible to the vicissitudes of between-cluster dispersal and the character of the intervening landscape (appendix M).

Number of pairs—Because empirical and modeling results both suggest that clusters of 15 to 20 pairs should be stable over the long term, even given low to moderate rates of dispersal among them by juvenile owls, and because many of the HCAs delineated do not contain homogeneous, unfragmented owl habitat, we concluded that HCAs should, wherever possible, contain or have the potential to contain 20 or more pairs of owls.

We believe that the system of HCAs suggested provides a very low probability that any given HCA with 15 or more pairs will lose all of its owls at the same time, especially in a network that includes many such habitat blocks separated by distances and habitat connectivity consistent with known owl dispersal capacity (appendix P). Indeed, such an arrangement of HCAs probably functions more like a single, interacting population than as a set of isolated subpopulations. On the other hand, even relatively large HCAs for owls have uncertain fates if they are currently well below their anticipated carrying capacity. Areas with HCAs in this condition, as in portions of the Coast Range in Oregon, will need to be closely monitored while owl habitat there recovers.

Models of population dynamics of long-lived vertebrates are difficult to validate. Perhaps the best confirmation of inferences from our model is that they are generally supported by results from empirical studies (appendix O). The output and inferences drawn from a model are always a reflection of the model's structure; our models are not exceptions. Clearly the patterns observed in simulations reflect the model's structure and the assumptions made about owl behavior. For example, our model and its results are the consequence of assumptions made about the dispersal behavior of juvenile owls within and between clusters. Unfortunately, little is known of owl dispersal behavior and movement patterns through heterogeneous landscapes (but see appendix P).

The theory that increasing HCA size will have a positive effect (with size defined by the potential number of owl territories within) is strongly supported by both empirical and theoretical studies. Populations quickly escape from the dangers of demographic stochasticity (random fluctuations in birth and death rates) with even slight increases in population size. Populations also gain security from environmental uncertainty with increasing numbers, but at a much slower rate than from demographic effects. Therefore, this result from modeling was not surprising. Of interest, however, was that marginal gains in mean occupancy with incremental increases in HCA size were not constant. Rather large gains occurred in moving from HCAs of 5 to HCAs of 10 territories; smaller gains were made in moving from 10 to 20 territories per HCA (appendix M). Models that considered the probability of occupancy of all territories within an HCA, as influenced by the size of the HCA and the amount of suitable habitat within it, yielded additional insights. The smaller the HCA and the less the amount of suitable habitat, the lower the percentage of the territories that are likely to be occupied at any one time. Therefore, the number of pairs of owls actually present at any point in the future will likely be less than the potential, as judged from the total number of suitable territories in the HCAs. These models provided information that was used to adjust the number of owl pairs that could be expected from all the HCAs in the network (see appendix Q, table Q3).

Setting the Distance Between HCAs

Dispersal in animals is the relatively permanent movement of individuals from one location to another. Usually dispersal is the movement of juveniles from their natal area to a site where they eventually breed. When large blocks of suitable habitat exist, the rate of successful dispersal from one block to another declines with increasing distance between them.

Based on available data from 56 juvenile northern spotted owls equipped with radio transmitters, we set the maximum distance between HCAs with at least 20 territory sites (at their nearest points of separation) at 12 miles (appendix P). This distance is within the known dispersal distance of about 66% of the owls studied (because we know of no objective criteria for setting such a distance, this decision was based on Delphi approach; see appendix P for discussion of the rationale). Owls that tend to disperse shorter distances will have opportunities to find vacancies in the breeding population within their natal HCA. Where existing conditions precluded delineation of HCAs large enough to contain at least 20 pairs, now or in the future, we opted for a shorter maximum distance between areas. This distance is 7 miles, which is less than the median dispersal distance estimated from 20 color-banded juveniles and within the dispersal range of more than 75% of all radio-marked juveniles studied (appendix P). Our intent was to increase the likelihood of successful dispersal from one HCA to another as compensation for the increased vulnerability of these smaller HCAs.

Connectivity Between HCAs

"Connectivity" is a measure of the extent to which intervening habitat truly connects blocks of suitable habitat to allow individuals, usually juveniles, of the species in question to disperse between them. Provision of habitat features that enhance dispersal between blocks is essential in a conservation strategy. Otherwise, individuals lost from the breeding population cannot be replaced by recruits (dispersing juveniles or displaced adults), and the population will decline. Providing a moderate amount of connectivity in the form of some forested habitat in that landscape allows dispersing birds to move more successfully from one HCA to another. We believe this increases the likelihoods of persistence, as estimated above, to very high for 50 years and high for 100 years over most of the range of the owl. These estimates, however, are too optimistic for many parts of the owls' range where we have identified problem areas (see appendices C and Q).

A recurrent theme in the literature of conservation biology addresses the need for successful dispersal to ensure population persistence and suggests that corridors of suitable habitat be provided between population centers. What constitutes a suitable corridor varies by species, and experts have expressed concern that narrow corridors may sometimes be more detrimental than beneficial (appendix P).

To address the question of the configuration and composition of habitat in the connecting zones between HCAs (see appendix P), we reviewed available data from dispersing juveniles equipped with radio transmitters. Juveniles tend to disperse in various directions from their natal areas, exhibiting little tendency to follow natural corridors created by topographic features. Dispersing juveniles generally passed through a wide variety of habitats not generally regarded as suitable for reproduction, but most juveniles exhibited selection for old-growth and mature forests during dispersal. No relation was found between the extent of forest fragmentation and either the final distance moved or the number of days survived by juvenile owls. This finding indicates that special "dispersal corridors" designed for this purpose are unlikely to lead owls from one HCA to another. Instead of specially designed corridors, therefore, we envision a general forest landscape between HCAs amenable to dispersal by juvenile owls.

For the most part, excepting checkerboard ownerships, current management practices should satisfy this objective. The validity of the proposed strategy depends as much on the condition of the habitat between HCAs as it does on the status of the HCAs themselves. If forest management plans are altered significantly to shorten rotations or to reallocate areas currently reserved from timber harvest for other purposes, the need for dedicated corridors between HCAs must be reexamined. In areas of checkerboard ownership, biologists have expressed concern about the dispersal of juvenile owls, but no available data indicate that a problem currently exists.

Many management practices, including those associated with certain timber harvest methods, provide habitat attributes conducive to spotted owl dispersal. Examples include visual corridors, riparian corridors, and streamside-management zones, all of which contain possible stopover spots. These habitat areas tend to be linear in configuration. Additional forested patches that can support dispersal remain unharvested for other reasons. Forests on lands incapable of commercial timber production, on soils prone to slumping, in special management areas for pileated woodpeckers and pine martens, and designated older forest blocks and extended rotation areas on both FS and BLM lands are examples that should provide suitable dispersal habitat for spotted owls. Furthermore, 50% of the landbase in a regulated forest would be older than 40 years, given a rotation schedule of only 80 years. We expect much of that managed landbase to be suitable for passage by dispersing spotted owls (appendix R recommends studies to evaluate this expectation). The standards and guidelines discussed later ensure adequate dispersal habitat by requiring that 50% of the forest matrix outside of HCAs be in stands with an average d.b.h. of 11 inches and a 40% canopy closure.

The general approach to the conservation strategy is summarized in table 1.

Table 1—Description of basic concepts used in developing a conservation strategy for the northern spotted owl[a]

Recommended strategy	Explanation
Habitat Conservation Areas (HCAs)	
Detinition	Contiguous block of habitat to be managed and conserved for spotted owls
Categories	Habitat that supports ~20 pairs Habitat that supports <20 pairs Habitat for dispersal and future nesting
Intent	Assure population viability Maintain distribution Enhance habitat conditions Reverse adverse situations Hedge against catastrophic loss
Forest Matrix	
Definition	Forest lands outside of HCAs
Categories	Lands suited for timber production Lands unsuited for timber production Reserved lands
Intent	Provide connectivity Maintain options for returning owls to forest matrix Provide opportunities to apply alternative silvicultural treatments

[a] See appendix Q—discussion of standards and guidelines.

Standards and Guidelines

The Rule Set

We developed standards and guidelines (appendix O) to apply the five basic concepts considered essential for a successful conservation strategy for the owl (see table 2). The primary data that underpin these standards and guidelines included:

- All portions of the range of the northern spotted owl in the United States were included in the conservation strategy.
- Ideally, HCAs should contain 20 or more pairs of owls. HCA size was determined by selecting areas known to contain, or that were estimated to contain, 20 or more pairs of owls. if that was not possible, the next largest possible HCA within the appropriate distances of other HCAs was designated. If land conditions were conducive to forest production, the sizes of these latter HCAs were adjusted upward to the point at which they should provide for 20 owl territories in the future, after currently unsuitable forests within them have grown back to a condition suitable for spotted owls. Where we were uncertain about the number of pairs occurring now, or that could occur in the future within an HCA, we determined the minimum size of the HCA from the median annual home-range size of an owl pair for that physiographic province, we assumed a 25% overlap between adjacent or potentially adjacent pairs, based on information on overlap between home ranges of "nearest neighbor" pairs obtained from radio-marked owl pairs (appendix I). Wherever (given site conditions) the target of 20 pairs could be attained, HCA size was estimated from the formula

HCA size = [(median annual home range of pairs) x 0.75] x 20 pairs.

Table 2—Description of standards and guidelines for the spotted owl conservation strategy[a]

Criteria	Rule
Habitat Conservation Areas (HCAs)	
Distribution	Widespread distribution across range
Location	Known pairs or potential to support pairs
Size	Sufficient habitat to support ≥20 p airs unless landscape limits ability to support ≥20 pairs[b]
Spacing	No more than 12 miles apart (HCAs with ≥20 pairs) No more than 7 miles apart (HCAs with <20 pairs)
Quality	Contiguous blocks of suitable habitat
Forest Matrix[c]	
Connectivity	Distribution of existing reserved lands and lands unsuited for timber management Retention of 80-acre stands of suitable habjtat around core areas (up to 7 per township) Maintain 50% of forest landscape with mean tree d.b.h. of 11 inches and 40% canopy cover

[a] See appendix Q—discussion of standards and guidelines.
[b] See table S—examples of application of the guidelines in those areas where 20-pair HCAs could not be established.
[c] All forest land outside of designated HCAs.
[d] These areas are a category of HCA.

This estimate was then compared with an HCA size based on known densities of owls in study areas within the applicable province. Other factors, such as the percentage of suitable owl habitat, elevation, and the intensity of surveys to locate owls, were also considered when boundaries of HCAs were delineated. If site-specific information on the amount of suitable habitat that a site could eventually produce indicated that delineating an HCA with 20 or more pairs would be impossible, the above formula for HCA size used the lower number of potential pairs instead of 20. Usually, we found close agreement between these methods for determining HCA size.

- Distances between HCAs were set at no more than 12 miles at the nearest separation for HCAs containing 20 or more pairs and no more than 7 miles for HCAs with 2 to 19 pairs (appendices P and Q).

- Adequate portions of the forested areas between HCAs must be in appropriate structural condition to provide at least marginal foraging habitat for dispersing owls. This need is addressed by requiring that 50% of the forest matrix outside the HCAs be covered with stands of trees averaging 11 inches or more in d.b.h., and with at least 40% canopy closure.

- At least 80 acres of suitable owl habitat should be designated as HCAs around activity centers of up to seven known pairs of owls per township in the forest matrix. These HCAs may provide core areas for nesting and foraging and allow reoccupation of these sites by owls in 50 to 80 years after harvest of the surrounding stands. Without provision of such areas, we believe the general managed forest of the future is less likely to sustain owls. Then, any chance to alter the HCA strategy proposed here for spotted owls will be markedly reduced.

In applying these standards and guidelines to maps (that is, on-the-ground conditions) we found them to be generally applicable. Some situations, however, did not allow us to apply the idealized conservation strategy. An example of each situation is described in table 3, along with the altered management strategy derived to deal with each situation (see appendix Q for further details).

Finally, we used the standards and guidelines to map locations of HCAs for the suggested strategy throughout the range of the northern spotted owl (see appendix Q and maps).

The HCA concept applies primarily to BLM, FS, and NPS lands, as delineated in the enclosed maps. The Committee strongly recommends that HCAs be established on State lands in certain key areas (as shown on the maps) to assure population connectivity. We also recommend that resource managers of other State lands, tribal lands, other Federal lands, and private lands use forestry and silvicultural techniques and practices that maintain or enhance habitat characteristics associated with spotted owls.

Table 3—Examples of application of guidelines in Areas of Special Concern for spotted owls[a]

Identified concern	Recommended strategy
Short term	
Habitat currently unable to support 20-pair areas Example: Oregon Coast Range	Delineate HCAs (20-pair minimum) Protect additional pairs until target densities attained
Long term	
Natural landscape limitations preclude 20-pair areas Example: Northern Washington Cascades	Establish HCAs with 2 or more pairs
Natural landscape limitations and low population density Example: Eastern Oregon Cascades	Protect known pairs
Insufficient public lands to create 20-pair areas Example: Northern California Coast Range	Establish HCAs where possible and recommend silviculture treatments to produce and sustain owl habitat

[a] See appendix c—discussion of Areas of Special concern; see appendix Q—discussion of standards and guidelines.

The Committee recognizes that management on private and State lands differs considerably from management on Federal lands. Therefore, we believe that management of suitable habitat on private and State lands should be carried out under the leadership of the States with the cooperation of private land owners. The States, with their cooperators, should prepare habitat conservation plans, as the State of California is doing, that specify how an owl population can be managed, and how the necessary monitoring and research to guide adaptive management will be carried out.

Management Activities Within HCAs

Activities within HCAs should be consistent with their primary management prescription to assure that owls in HCAs have a high probability of persistence (details in appendices O and Q). in particular, forests in HCAs should be maintained in superior habitat condition for owls, and younger forests and logged sites should be allowed to mature into superior habitat. Therefore, logging (including salvage operations) and other silvicultural activities (with exception of stand regeneration) should cease within HCAs. Silvicultural treatments that can be shown to benefit owls may be an exception to this rule in the future. The development and testing of such methods should be a major focus of research and management over the next several decades (appendices R and S). Such treatments will be largely experimental in the short term, so they should be tested outside of the HCAs.

Road construction in HCAs is discouraged because it detracts from the quality and amount of owl habitat. Roads should be located in HCAs only when no feasible alternative is possible. When roads are constructed in HCAs, they should be located and engineered to minimize the loss and alteration of habitat. Roads should not come any closer than 1/4 mile to the activity center of any owl pair.

Some timber sales are currently being prepared within proposed HCA boundaries, such as under provisions of the Hatfield-Adams amendment (Section 318 of Public Law 101-121), to be offered for sale and award in 1990. All of these sales under planning should be shifted to areas outside of HCA boundaries. If options for shifting are not available, then recommendations for awarded sales are followed, as explained next. No sale should be planned within HCAs past fiscal year 1990.

Undoubtedly, other timber sales have been awarded within HCA boundaries, but not yet cut. Cancellation of these sales would result in significant costs to taxpayers and considerable economic and social disruption. These awarded sales may proceed on the condition that they have been intensively surveyed (at least six visits will be needed to conclude no owls are present) for the occurrence of pairs. If a pair exists, all sale units within 1/2 mile of the center of owl activity should be excluded from the timber sale through standard modification procedures. The result may entail buyback of the units.

Management Plans for HCAs

Management plans will be needed for each HCA to evaluate their vulnerability to fire, windstorms, and damage from insects and diseases. The loss of all suitable habitat in an HCA could create a gap between HCAs of much more than 24 miles, which would be a serious problem for the strategy. Each of these plans will need to seek resolutions between conflicting resource needs, but the overriding consideration should be regenerating and maintaining superior spotted owl habitat. For example, prescribed fire may sometimes be considered for use in HCAs. Plans for such fires must strike a balance between reducing fuel loading, which could carry a conflagration through HCAs, and retaining sufficient downed trees and woody debris. The decomposition of downed wood is needed for growth of subterranean fungi, which are a primary food source for the flying squirrels and other small mammals that are prey for the owl. Woody debris also provides cover for small mammals.

Where HCAs include Wilderness Areas, the FS and BLM should reconsider their current fire policies in light of the value of individual HCAs to the comprehensive conservation strategy for owls. A similar re-evaluation should take place for National Parks.

Number of Northern Spotted Owls

A Target Number

Before we began delineating HCAs on maps, we agreed that we should consider recommendations from experts who had previously examined the question of how many owl pairs should be afforded habitat protection. The "blue-ribbon panel" convened by the Audubon Society recommended that "The management program for spotted owls in Oregon, Washington, northwest California, and the Sierra Nevada should be directed to maintenance of a minimum total of 1500 pairs of these birds."[4] This estimate included both the northern spotted owl and the California spotted owl. If the California subspecies in the Sierra Nevada is excluded, the estimate for the northern spotted owl would have been 1100 to 1200 pairs. We attach no particular value to this number of pairs except to note that it was suggested by experts who carefully considered the situation and voted their collective opinion. We also point out that the Audubon Panel stated that they were "…marginally comfortable with this number."

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[4] Dawson, W. R., J. D. Ligon, J. R. Murphy, 4. P. Meyers, D. Simberloff, and 4. Verner, 1986. Report of the advisory panel on the spotted owl. Audubon Conservation Report 7. National Audubon Society, N.Y. Pp. 32-33.

The Panel expressed less concern over the potential for heterozygosity loss and possible inbreeding depression (that is, genetic problems) than with demographic arid environmental stochasticity. Their recommendations on population size were rooted in the latter concern. We concur. We are concerned about possible genetic problems only for the isolated population on the Olympic Peninsula. We can do little to solve this problem in the short term except to protect that population, and possibly introduce young owls from other parts of the distribution in Washington and even Oregon. In the long term, we seek to improve habitat conditions in areas that could provide demographic (population) continuity with the remainder of the owl's range.

Total Numbers of Pairs in HCAs

The total number of pairs in HCAs will probably exceed the suggested minimum number from the Audubon Report (table 4). The HCAs proposed for FS, BLM, and NPS presently include 925 known pairs of owls. Most of the proposed HCAs still have not been completely surveyed, and we believe the number of known pairs underestimates the true number likely to occur within HCA boundaries. To estimate the probable number of pairs within HCAs, we drew on several sources of information-a study of available suitable habitat in each HCA and current knowledge about mean and median home-range sizes in various geographic provinces (see appendix I); the considerable personal knowledge and experience of team members; knowledge of owl densities occurring in comparable habitats from each of the geographic provinces; and in-depth consultation with experienced agency field biologists familiar with conditions in particular HCAs.

Based on the above information, we currently estimate a total of 1465 pairs in the HCAs on Federal lands. The comparable estimate for SOHAs is 880 pairs. Furthermore, we believe the proposed strategy, given time for young forests within HCAs to attain suitable habitat condition over a period of 30 to 150 years, could provide habitat capable of sustaining about 2000 pairs on Federal lands, assuming 100% occupancy of all territories. Occupancy, however, will be less than 100%, because of demographic and environmental uncertainty (appendix M). Incorporating these measures of uncertainty provides an adjusted estimate of about 1750 pairs in HCAs on Federal lands by the year 2100. In addition, we believe a strong possibility exists that the States, acting in cooperation and concert with private land owners, will provide habitat for additional pairs that will further increase security for the owls. We estimate this capability at about 400 pairs by 2100. By contrast, we would expect the number of pairs sustained by the SOHA network to decline during this period, not to increase. Finally, a significant number of floaters should be present in the HCAs, available to fill vacated territories or to replace the loss of one member of a territorial pair. We cannot estimate the potential number of these floaters because they live unobtrusively in the population and are not readily detected or captured.

We are somewhat reassured that the resulting number of pairs known to occur on HCAs in Federal lands, alone, presently exceeds the minimum number accepted by the Audubon Panel. We are even more optimistic about the future because implementing this strategy promises to significantly increase the number of owls as younger forests in HCAs are allowed to mature and become superior habitat for spotted owls.

Table 4—Pairs of spotted owls in mapped Habitat Conservation Areas

State Ownership	Pairs presently known[a]	Total pairs presently estimated[b]	Pairs expected in the future[c]	Adjusted pairs expected in the future[d]
Washington				
Forest Service	200	257	428	369
National Park Service	20	87	90	85
State	6	10	101	89
Other Federal	0	0	14	12
Subtotal	226	354	633	555
Oregon				
Forest Service	245	467	647	589
Bureau of Land Management	185	265	320	285
State	0	4	80	72
Subtotal	430	736	1047	946
California				
Forest Service	258	341	452	372
Bureau of Land Management	14	28	43	21
National Park Service	3	24	39	38
State	18	42	50	22
Private	NA[e]	218	238	215
Subtotals	293	653	822	668
Totals	949	1,743	2,502	2,196
Totals by ownership				
Forest Service	703	1065	1527	1330
Bureau of Land Management	199	293	363	306
National Park Service	23	111	129	123
Other Federal	0	0	14	20
States	24	56	231	175
Private	NA[e]	218	238	215
Totals:	949	1,743	2,502	2,196

[a] Numbers of spotted owl pairs found in HCA areas during 1985 to 1989.

[b] Number of pairs estimated to occur in the HCAs, based on an assessment of several factors including known locations, home~range size, amounts of suitable habitat, elevation, and past survey effort.

[c] Number of pairs expected in the future after habitat recovers, based on home-range size and density adjusted for expected habitat conditions. This assumes 100% occupancy of home ranges (see appendix M).

[d] Number of pairs expected in the future, calculated in c above but adjusted for demographic and environmental uncertainity (see appendix M).

[e] Present inventories on private lands are insufficient to determine the number of present pairs: future pairs based on recommended density estimates per township.

Spotted Owls in the Managed Forest Outside of HCAs

Further, we believe that some number of owls will continue to live outside the HCAs. These birds will likely live as single pairs and floaters, relatively isolated from other owls (compared to those in HCAs). They will be subject to the increased vicissitudes of life which are the anticipated results if isolation brought about by fragmentation and reduction of their habitat continues (appendices N and O). Many of the singles and pairs are likely to disappear, and the territories are apt to be vacant for prolonged periods or occupied by only one owl (appendices M and O). They

will, however, provide a source of immigrants for HCAs and provide a hedge against unforeseen events, for as long as they exist. If given appropriate forest management, some of these birds may also be able to persist in viable numbers. If so, that would be reason to rethink the HCA strategy. But that remains to be demonstrated.

Leaving Options to Adapt Management

On the surface, this conservation strategy may appear too conservative to some people. We think it is not. The Audubon Panel recommendation was a minimum estimate with which they were only "marginally comfortable," and it was only that—an estimate based on their general evaluation of evidence available at the time. We must consider that the success we anticipate for this conservation strategy may be too optimistic; it has yet to be tested. The future habitat conditions we visualize have never existed before. We face a rapidly decreasing ability to designate additional habitat for owls if the assumptions used to construct the proposed strategy prove deficient.

The quality, arrangement, and distribution of HCAs are especially critical. Numbers of owls are also important. In particular, some minimum number of owls and the nature of their demographic interaction are essential to assure genetic viability (no loss of heterozygosity, no inbreeding problems). Authorities who have addressed this question consider genetic problems secondary to those of demography. We agree. Our approach has been to develop a strategy with an array of HCAs providing a high probability for the long-term persistence of spotted owls, and arranged so as to facilitate owl movement between HCAs to assure demographic interaction among them. This interaction also vitally contributes to genetic viability.

We believe, for example, that 3000 pairs of owls distributed across the landscape in solitary SOHAs, many isolated from others by 6 to 12 miles, would be less viable over the long term than 1500 pairs in clusters, distributed in a smaller number of HCAs. Existing numbers and distribution today are much less significant than what can be anticipated to exist in the future. Today is merely the departure point. Conditions have been changing yearly with the annual removal of 71,000 acres of owl habitat by logging on National Forests alone.

Furthermore, we believe random environmental events will occasionally destroy portions of HCAs to an extent that cannot be accurately predicted. In short, we dare not prescribe less and still hope to remain confident that a high probability of success exists to maintain the long-term term viability of the northern spotted owl.

Expected impact of Habitat Reduction on Numbers of Owls

Reduction on Our strategy does not call for saving all remaining owl habitat or all remaining old growth. Rather, it is based on establishing a distribution of owls and their habitat to provide for long-term viability. In a worst-case scenario, we estimate that the strategy could result in a 50 to 60% reduction in current owl numbers. This figure assumes that all pair sites outside of HCAs will eventually be lost through habitat removal or become permanently vacant because of demographic factors resulting from increasing isolation.

But that is a worst-case scenario. What we consider more likely is that some number of owl pairs will occur outside of HCAs, particularly in areas reserved from harvest for other reasons and in stands managed on more than 120-year rotations (many of which exist throughout the owl's range). Other places where owls may occur, intermittently at least, are in Wilderness Areas, parks, and lands containing owl habitat that are not deemed suitable for timber production. The HCAs will probably be the long-term source of owls needed to periodically restock such territories.

Further, many of the relatively isolated pairs that now exist are likely to disappear, to have reproductive rates below those needed to maintain viability, or to have a low chance of recolonizing vacated habitats. Demographic studies (appendices L and M) indicate the likelihood of these losses. Thus, some significant portion of the loss in numbers anticipated under the proposed strategy would occur even under a strategy where all remaining suitable habitat was maintained.

We believe any attempt to protect individual pairs, as the sole strategy, is destined to fail (appendices M, N, and O). In any strategy that we may propose, a reduction in numbers of owls from the present number is a foregone conclusion. The reduction will continue until an equilibrium between available habitat and the number of owl pairs is attained. This equilibrium will not occur in the proposed conservation strategy until all potential habitat within HCAs has developed conditions suitable for spotted owls, and until the surrounding landscape matrix is in a state of equilibrium between timber harvest and losses to natural causes on the one hand, and regeneration of wood fiber on the other (that is, sustained yield).

Opportunities to adjust the strategy to protect additional suitable habitat will continue in some portions of the range for 5 to 10 years but will diminish at an increasing rate. Unless research can show more quickly than we expect that viable populations can be supported in managed forests, the spotted owl depends on our estimates of what is required. On the other hand, if the present strategy is found to be excessive or no longer needed, many options will remain for modifying the initially imposed management actions.

Adjustment to an Equilibrium Population

An implied assumption of this conservation strategy is that the owl population will reach a new, stable equilibrium at some future time. We are confident in this assumption, even though the amount of suitable habitat and the number of owls will continue to decline over the short term. We hypothesize that once the rate of loss of suitable habitat outside HCAs comes into balance with the rate new habitat is recruited within the HCAs, a stable equilibrium will be attained. This equilibrium will, of course, be at a lower population number than existed historically. Further, because the spotted owl has a low reproductive potential, considerable time may be required for the population to stabilize at a new equilibrium number.

We cannot demonstrate with complete certainty that a new equilibrium number will be attained. Our conservation strategy, however, addresses the key aspects of the owl's life history that influence its prospects for long-term viability (see appendices L and M). A system of large HCAs increases the likelihood of successful dispersal of both adult and juvenile birds. It increases the expected occupancy of suitable pair territories and thus enhances reproductive output. Finally, results from our simulation models, which were structured on the basis of and use parameter values according to our understanding of owl biology and behavior, have shown that owl populations do reach equilibrium, given an extensive system of HCAs averaging about 20 suitable pair-sites and encompassing about 25% of the forested landscape.

Adaptive Management and Monitoring

We have developed proposals for adaptive management (appendix R) that rely on monitoring to determine whether the conservation strategy maintains a well-distributed, persistent population of owls, and which depend on research that seeks ways to resolve conflicts between conservation of owls and continued timber harvest.

Monitoring

Monitoring is the primary method for determining whether or not the conservation strategy is accomplishing its intended objectives. We have reviewed the current monitoring program used by the FS to monitor its SOHA network system. We conclude that, if certain thresholds are passed as owl habitat continues to decline around the SOHAs the existing monitoring program is unlikely to tell us in time to take action to avert possible extinction of the owls. This inability is caused by lag effects resulting from the long life span of spotted owls and from packing phenomena—where remaining suitable owl habitat becomes crowded with owls displaced from habitats lost elsewhere. Inferences drawn only from the number of occupied SOHAs will continue to indicate a "viable" population. If the SOHA network is not viable, however, and we believe for several reasons that it is not (see appendices M, N, O, and P), a sharp decline in numbers is likely to ensue within a few years after the SOHAs become clearly separated from one another in a landscape of habitat generally unsuited for owl breeding.

For the HCA strategy proposed here, we recommend monitoring habitat and demographic information (appendix R), including banding as many owls as possible, in selected units that include two or more HCAs and the intervening landscape. This approach would provide information on occupancy rates within HCAs, reproductive; activity of owls in and between HCAs, and dispersal of birds between HCAs. tion on the sources and ages of birds that replace members lost from the popuiatioii within HCAs (so-called "turnover events") may provide the best measure of whether the conservation strategy is succeeding. Studies of this sort have been underway several years, and have proved feasible. We also have preliminary assessments of the cost of such a program, which suggest that it will be no more costly than current monitoring efforts.

Research

Primary objectives of the research proposed under adaptive management are to find ways to extend the period during which forest stands subject to timber harvest are suitable for breeding owls, to learn how to manage existing younger stands to develop conditions suitable for owls sooner than would naturally occur, to learn how to grow suitable owl habitat from bare ground sooner than would naturally occur, and generally, to determine whether silvicultural alternatives can be found that will allow spotted owls to maintain viable populations in managed forests. We emphasize that answers to these research questions will be slow in coming.

The research program implements management experiments that simultaneously evaluate alternative landscape arrangements and stand treatments. Subsequent changes in management may increase protection for the owls or relax constraints on forest production, based on experience gained from the management experiments. This program provides an opportunity for managers and researchers to work together in testing explicit assumptions in the standards and guidelines that drive the conservation strategy. Some management experiments can and should be done in partnerships that include agencies, institutions, and industry. Standard protocols for research design, data collection, and analyses must be developed and agreed upon by all cooperating parties. Only then can we make reasonable comparisons from area to area and from study to study.

Producing Habitat Through Innovative Silviculture

Past forestry practices have inadvertently produced some habitats where owls are breeding successfully 60 to 80 years after the event. Similar suitable habitat could reasonably be expected to be produced by silvicultural design. Therefore, we recommend obtaining maximum information from owl pairs that will be influenced by timber harvesting in sites between or around HCAs, and in northwestern California where owls occur in good numbers in redwood forests 40 to 80 years old. Information so gained could lead to new silvicultural treatments that maintain or create owl habitat (appendix S).

Silvicultural modifications may include producing multilayered canopies in stands, and leaving structures such as large trees, snags, and fallen trees in place. If such treatments prove successful for producing owl habitat, timber sales of certain types might eventually be scheduled in HCAs. But such sales can legitimately occur only after conclusive data are obtained showing that associated owl populations are stable or increasing, and after verifying positive owl responses to stands that have been so treated.

Our impression, from detailed working sessions with foresters and silviculturists, is that departing from traditional, even-aged forest management to provide owl habitat will likely entail loss of growing space for trees and, hence, of economic return. But they expressed confidence that various procedures could be implemented to accelerate the development of conditions suitable for owls, and to prolong the period of suitability in stands that will eventually be logged too heavily to provide useful owl habitat. We need to test some of these silvicultural systems and evaluate their cost-benefit ratios.

Furthermore, research into the question of producing suitable owl habitat should also consider the value of such habitat for other species and other values associated with such forest conditions. The focus of this research should not long be confined to owls. We need to be cautious because, as we become adept at producing forests tailored specifically to the habitat requirements of the northern spotted owl, we might produce forests unsuitable for other species associated with old forests.

Geographic Information Systems

We recommend developing and using geographic information systems (GISs) linked with software for predicting forest growth and yield, including the ability to identify habitat that supports pairs of owls. A GIS will allow users to simulate and analyze changes in forest stands and landscapes in terms of owl habitat, thus expanding our ability to plan management experiments or schedule stand treatments to produce for sustain owl habitat. A GIS enables decision makers to understand and comment on the involved analytical processes, resulting in ecologically based policy decisions and better linkages between researchers and managers. These systems should be interactive among all users and encompass all land ownerships.

Evaluating the Strategy and Being Prepared to Adjust

Altogether, the adaptive management program must determine the aggregate value of forest management to maintaining owl persistence in HCAs, and single and multiple pairs in the surrounding managed forests. The primary challenge for the immediate future (5 to 10 years) is to determine whether our assumptions about HCA sizes, configurations, distribution, and connectivity are correct. Therefore, cooperators, must develop an objective process to assimilate results of management experiments and monitoring to permit review and evaluation of the HCA-based conservation strategy, and to modify it if so indicated.

Other Research Needs

The Committee was directed in the Charter to consider future research on spotted owls. Questions that need to be asked largely depend on what strategy is adopted for owl conservation. When that becomes clear, the Committee will reconvene to make recommendations on appropriate research. We will also consider in more detail the question of a reliable and workable monitoring system.

Risk Analysis

In general, smaller and more isolated populations of any species are much more susceptible to extirpation than larger, freely interacting populations. Viability is thus more certain when populations—and habitats for breeding, feeding, dispersal, and other life needs—occur in widely distributed, yet demographically contiguous patterns. Specific objectives for maintaining owl population viability include providing high-quality habitats in HCAs large enough for multiple pairs, spacing HCAs close together in a landscape containing habitat suitable for dispersal to ensure high likelihoods of HCAs being locally recolonized from other HCAs, and providing for a wide distribution of HCAs to facilitate interaction among geographic locations and protection against localized catastrophes.

The conservation strategy proposed here provides all of these viability requirements. We conclude that the proposed conservation strategy has a very high probability of sustaining northern spotted owls in viable numbers for at least 50 years (appendix T, table T5). The situation, however, varies across the range of the owl (appendix T, table T2). Further, during that 50-year period, the strategy is expected to improve conditions for owls in areas where the subspecies persists in marginal conditions. Given continued improvement, we conclude that this conservation strategy has a high probability of assuring a viable population of spotted owls for 100 years (see appendix T, table T5).

Comparison With Current Management

A comparison of the SOHA and HCA strategies leads us to recommend that most of the SOHA system be abandoned in favor of HCAs. The SOHA system manages for owl pairs or small clusters of two and three pairs; by contrast, the HCA system manages for larger assemblages of pairs, ideally at least 20 pairs per cluster. We believe the SOHA network system to be a prescription for the extinction of spotted owls, at least in a large proportion of the owl's range (see appendices M, N, O, and P).

- Every study of the persistence of bird populations shows that the likelihood of extinction increases dramatically with decreasing numbers of pairs in a block of habitat. Consequently, we expect pairs in SOHAs to disappear at a relatively high rate, making the vacated SOHAs at least temporarily nonfunctional. This loss considerably worsens dispersal problems.

- In contrast, the loss of one or even a few pairs of owls from a large HCA subpopulation would not make that HCA a nonfunctional component of the full network of HCAs. The recruitment of replacement individuals for lost members of pairs should occur more rapidly in HCAs than in SOHAs, because recruits can come from within the HCAs themselves (but not from within SOHAs, which depend solely on outside sources for recruitment).

- Where several pairs of birds occur in a cluster, social interaction among owl pairs would almost certainly increase calling frequency (if this were not true, observers should not be able to elicit calling from silent owls by imitating their calls). The higher calling rate expected in HCAs, by comparison with SOHAs, should provide a sort of "vocal guidance" that would help dispersing birds find an HCA. This effect would be minimal at SOHAs.

- Large HCAs reduce the effects of habitat fragmentation and edges, which are major concerns for a species threatened with the systematic removal of suitable habitat (see appendix N). SOHAs, on the other hand, have a high ratio of edge to area, so edge effects are more extreme than in HCAs. Logging between patches of habitat left for spotted owls also internally fragments SOHAs, and makes them particularly vulnerable to windstorms.

- Small-scale catastrophes would have less impact on HCAs than on SOHAs. SOHA destruction removes that unit from the network for perhaps 80 to 150 years and increases the mean dispersal distance between remaining units, further reducing the SOHA network's ability to maintain a viable population. Destruction of an equivalent area in an HCA, however, removes only one pair from the unit. The HCA unit remains viable, and dispersal distances are not particularly influenced.

- Floaters exhibit behavioral dynamics toward breeding bird populations that that would not seem likely toward individual, isolated pairs of breeders. We believe would not provide sufficient conditions needed for the successful recruitment of floaters into the breeding population. In contrast, the strategy proposed here provides larger HCAs that should allow dynamic interaction between breeding pairs and floaters that more closely approximates that found in unfragmented habitats.

- Finally, we believe a more effective monitoring program is possible with HCAs than with SOHAs, because the HCA system lends itself to a study design that would produce information on key population attributes (for example, birth and death rates, turnover events, immigration and emigration rates, and dispersal effectiveness) that are more likely to tell us when the population is in trouble than are simple population counts (see appendix R).

Administrative Mechanisms

A significant consideration when the adequacy of existing regulatory mechanisms and management activities for the owl are evaluated is the vigor, quality, and consistency of implementing and coordinating management plans. Adequately managing owl habitat implies common understanding, coordination, effectiveness, and the consistent application of agreed-upon plans, both within and among State and Federal land-management and other natural-resource management agencies. Ongoing, standardized, coordinated, and consistent monitoring of results for compliance with management plans, and for the response of owls to the conditions that result from those plans, is vital to success. The monitoring program is the primary feedback mechanism in adaptive management. Results from the monitoring effort must be the guide whenever adjustments in management regimes are considered.

Coordination Required

Administrative Nightmares

The occupied range of the owl extends across portions of Oregon, Washington, and California in the United States, and also across portions of British Columbia in Canada. Within the United States, existing regulatory mechanisms and their interactions present significant barriers to appropriate, coordinated management that must be overcome. California, Oregon, and Washington each have various authorities and regulations that affect the management of the owl and its habitat.

In each State, two agencies (the wildlife agency and the forestry agency) have some responsibility for owls or their habitat. Authorities and relationships among these agencies differ markedly among States. Further, the authority of the State forestry agencies applies primarily to State and private lands. These agencies issue regulations and administer State laws that govern forest practices on lands they manage and on private lands. These regulations take into account the fact that private and State lands do not have multiple-use mandates, and that most are managed primarily or solely to produce maximum revenues. Conversely, the authority of the wildlife agencies extends across all land ownerships in each particular State. Management constraints imposed for environmental, wildlife, or fish purposes, however justified, create direct or opportunity costs for the landholder. Current management schemes for such properties, with some minor exceptions, are not conducive to large-scale production or maintenance of habitat for owls.

Most habitat currently occupied by significant numbers of owls is owned in common by the people of the United States (the Federal Lands). Seventeen National Forests and five BLM Districts contain most of the remaining suitable habitat for the northern spotted owl. The seventeen Forests with owls occur in two administrative Regions. Although these Regions are governed by the same laws and regulations, management approaches differ between Regions and among National Forests within each Region (appendix D). Communication between Regions is not cultivated, perhaps because of the long-standing traditional policy of decentralized agency control. Management prerogatives are guarded.

Lands managed by the BLM largely occur in a checkerboard pattern, and primarily in alternating square-mile blocks of private and public ownership. Management of these lands is guided by a different set of laws, regulations, and mandates from those of the National Forests. Other significant Federal landholdings in the owl's range occur in eight NPS areas that operate under yet other laws and mandates.

The FWS is responsible for determining if the owl is to be listed as a threatened species and, if so, to assume leadership with six State and three primary Federal agencies to assure "recover of the owl. Obviously, overlapping and sometimes conflicting laws, regulations, and agency mandates seriously challenge the successful execution of any owl conservation strategy. Our investigations (appendices C and D) revealed differing management activities and levels of concern among State agencies, between Federal agencies, and within the administrative units of the various agencies. We believe that current administrative mechanisms constrain the managers responsible for designing, establishing, coordinating, and carrying out an effective management strategy for spotted owls. A comprehensive monitoring scheme that covers all land ownerships should be developed. A unified database and a coordinated, interagency-interstate strategy are likewise needed. Considering the continuously burgeoning biological, economic, political, and social consequences ensuing from a consideration of the status and management of the owl, we believe that developing and instituting a fully coordinated program of management, monitoring, research, and development, which operates across all of the landscape that makes up owl habitat, is both essential and overdue. Spotted owls, after all, are oblivious to our political and institutional boundaries.

Coordination Inadequate

No plans have been made within, and certainly not among, concerned management agencies to determine what population or habitat conditions signal that changes in ongoing management are required, or possible, to ensure the welfare of the owl. Rapid changes in land management obviously have occurred in response to changing political situations and climate, as evidenced by the Hatfield-Adams Amendment, the formation of our Committee, and the temporary increases in the number and size of SOHAs on NF and BLM lands. We believe that "trigger points" in ongoing monitoring efforts should be set that would dictate a re-evaluation of existing management operations. These trigger points should be explicitly stated and followed.

The following list provides some general ideas on which trigger points might be developed. We do not offer these suggestions as the final word because this important aspect of the strategy will depend in part on what we learn from monitoring. These issues could be addressed in more detail, for example, by the spotted owl coordinating group recommended by the Committee. Trigger points might be reached whenever:

- The number of owl pairs found in HCAs rises above or falls below the expected number by some specified percentage (for example, 25%).
- The number of pairs in HCAs exhibit marked declines or increases in number with in a reasonable period (say 10 years) after monitoring has been fully implemented.
- The amount of suitable habitat exhibits some continuing downward trend as a result of frequent natural disturbances, such as fire.
- The current forest land allocation changes significantly in the forest matrix surrounding HCAs.
- The current rotation schedules for harvesting timber in the forest matrix surrounding HCAs significantly change.

Concerned Federal (BLM, FS, FWS, and NPS) and State agencies (CRA, ODFW, and WDW) have formed the Interagency Spotted Owl Committee (ISOC) with the intent of coordinating activities for managing the owl. We believe that a committee must establish a mechanism for assuring coordinated research, development, and monitoring of owl habitat, numbers, locations, and distribution. That mechanism must also assure compliance with an agreed-upon management strategy across all involved Federal lands and those private and State lands that are included in the management strategy. We recognize that the Federal agencies have low credibility for managing the owl among the conservation and scientific communities. That perception must be quickly changed through the adoption, and prompt and vigorous institution, of a fully coordinated and sound conservation strategy by all concerned agencies.

Monitoring, research, and development activities must then continue in a likewise coordinated fashion for the conservation strategy to succeed both biologically and politically. The function and credibility of that comprehensive conservation strategy can be seriously compromised by a failure in its weakest link. We believe that the weakest link is apt to be inadequate coordination between concerned agencies resulting from various efforts to protect management prerogatives and entrenched ways of doing business.

Suggested Organization

We do not consider ourselves expert in administrative matters. We recommend, however, the appointment of a coordinator to oversee the conduct of whatever conservation strategy is adopted. That coordinator, who may be an employee of any one of the concerned agencies (BLM, FS, FWS, and NPS), should have assistants assigned (full- or part-time as required) from each of the other Federal agencies. in addition, the coordinator should be able to call on a representative from each of the States, appointed by appropriate agency heads, to participate in any activities concerning owls within their State. Including a mechanism for one advisor-observer each from industry, private-land owner, and environmental groups may also be appropriate. Research and development—and the planning and execution of monitoring— should be under the auspices of this group; it should have the additional duty of considering and advising managers on any necessary alterations to the conservation strategy.

Obviously, the map-based conservation strategy presented by our Committee is site-specific and may need adjustment to address unforeseen circumstances. Local situations will arise from time to time that must be addressed. The conservation strategy, however, is one for the entire geographic area. Proposed changes should be considered in that Fight by the broad representation of the coordinating committee.

A possible organizational structure for meeting the challenge presented by a coordinated conservation strategy is presented in figure 1. We attempted to diagram the current situation several times and concluded that it is so confused as to preclude clear description. We recognize that what we suggest will require a new way of doing business. But the issue is too significant and the consequences of failure too great to allow long-standing institutional barriers to stand in the way. We believe that the organization suggested here could accommodate the activities that relate to any species of such high concern as the spotted owl, including any species listed as “threatened” or “endangered” that occurs on Federal lands in the Pacific Northwest.

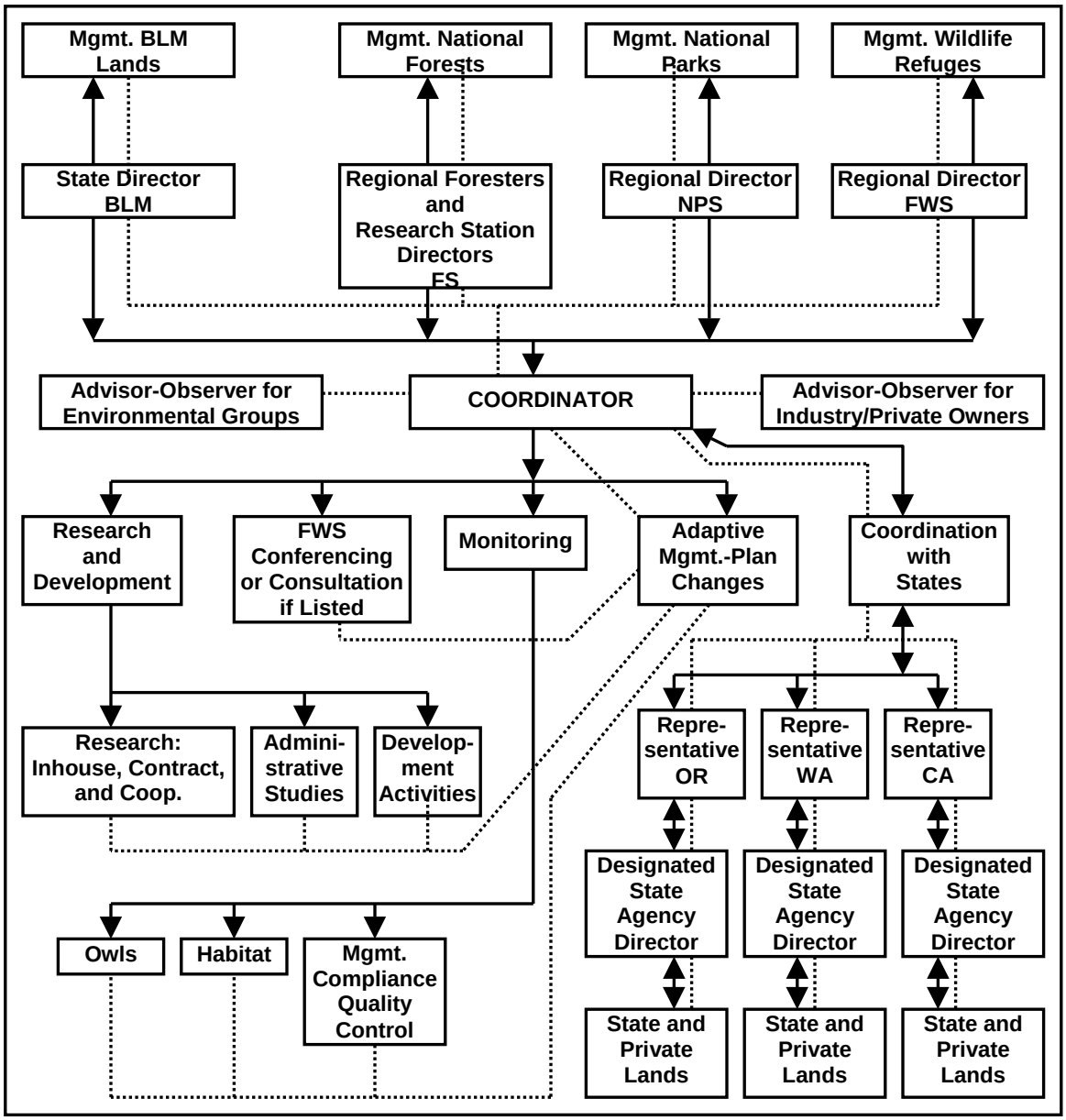

Figure 1—A suggested organization to achieve a coordinated conservation strategy far the northern spotted owl. Solid lines represent lines of authority and communication; dashed lines represent information feedback to facilitate adaptive management.

Assessment of Impacts

Our assignment was to develop a credible conservation strategy for the owl. We are aware that others will quickly analyze the effects of implementing the strategy we propose here. The immediate response, quite likely, will be to focus almost solely on the economic and social impacts of implementing the strategy in terms of its effect on the availability of timber. Such analysis is important. Adoption of the conservation strategy, however, has significant ramifications for other aspects of land management. A balanced assessment of this strategy's various impacts must consider water quality, fisheries, recreation, soils, stream flows, scenic values, biodiversity, and other species of wildlife. All aspects of such a decision should be weighed in the balance. The issues are not limited to questions of owls and timber supply, as important as those are. The matter is not that simple—it never has been. The entire "spotted owl issue" is just one of many related concerns, all of which should be considered.

The strategy of providing large, relatively intact blocks of suitable owl habitat may not need to be sustained in the long term, depending on the success achieved in maintaining owls on managed forest lands in Oregon, Washington, and northern California. This conservation strategy is designed to sustain the spotted owl—a long-lived bird that can fly between patches of suitable habitat. The landscape design may be less suitable for nonflying invertebrates and vertebrates, particularly reptiles and amphibians, that may be associated with structurally diverse forests. Populations of most of those species, however, should be nearly or totally self-sustaining within HCAs, with a high probability of long-term viability because individuals are likely to number in the several hundreds or thousands.

Postscript

We were asked to do a scientifically credible lob of producing a conservation strategy for the northern spotted owl. We have done our best and are satisfied with our efforts. We have proposed. It is for others—agency administrators and elected officials and the people whom they serve—to dispose. That is the system prescribed in law. It seems to us a good one. We can live with that.

A

A Charter for an Interagency Scientific Committee to Address the Conservation of the Northern Spotted Owl

Purpose:

Form an Interagency Scientific Committee under the authority of the Interagency Agreement of August 1988 between the USDI Bureau of Land Management, USDI Fish and Wildlife Service, USDI National Park Service, and USDA Forest Service regarding development of a conservation strategy for northern spotted owl management and cooperation.

Task Directive for the Scientific Committee:

General:

Develop a scientifically credible conservation strategy for the northern spotted owl.

Specific:

Short Term: 1989-90—Review the biological basis of U.S. Fish and Wildlife Draft Criteria for the Review of timber Sales (7/21/89 revised 8/09/89) and the basis for conference opinions.

Assess whether current land management strategies of the agencies are reserving options that will allow for long-term strategies to conserve the northern spotted owl.

Provide recommendations to preserve the necessary conservation options from now until the conservation strategy is completed. These may have to consider variables such as legislation or judicial review.

Long Term: 1991 and Beyond—Define habitat relationships for the long-term conservation of northern spotted owls.

Suggest possible options to achieve the amount and configuration of habitat for long-term northern spotted owl conservation throughout its range.

Evaluate current research efforts and identify research, monitoring, and inventory programs to answer existing critical questions and to track the adequacy of management strategies and recommendations.

Appendix A: Charter

Structure:

The Scientific Committee will consist of a Team Leader and Scientists from the Federal agencies involved. The members of the Committee are to be educationally and professionally qualified scientists.

Scientific Committee Members:

Jack W. Thomas, Team Leader
Chuck Meslow, FWS
Eric Forsman, FS
Jared Verner, FS
Butch Olendorff, BLM
Barry Noon, FS

Primary Contacts:

A representative from each of the four Federal agencies will be the primary contact for the Team Leader. These agency representatives will be responsible for pr the resources for the team to carry out its responsibilities. Technical experts will be made available to the committee upon request by the agencies.

Agency Representatives:	***Alternates:***
Robert Smith, FWS	Marv Plenert, FWS
Hugh Black, FS	Phil Lee, FS
Stan Butzer, BLM	Paul Vetterick, BLM
Jim Larson, NPS	Bill Briggle, NPS

Observers of the Scientific Committee:
Knowledgeable observers will be invited to all proceedings of the Scientific C tee. These observers will represent the following interests or entities:

State of California
State of Oregon
State of Washington
National Park Service
Forest Products Industry
Environmental Community

The Team Leader may invite technical experts or others to provide support to the committee.

The Team Leader in consultation with the Agency representatives and appropriate State officials will select the observers.

Timeline:

The Scientific Committee will provide a progress report to the Agency representative by November 1,1989.

Appendix A: Charter

The Scientific Committee will provide an interim product to be submitted to the public record for the U.S. Fish and Wildlife Service by December 20, 1989.

The final report of the Scientific will be completed by March 1, 1990.

Funding:

Individual travel and salaries will be covered by the respective agencies. Rent and other support costs will be shared as decided upon by the Agency representatives.

/s/ George M. Leonard
for F. DALE ROBERTSON
Chief
Forest Service

/s/ John F. Turner
JOHN TURNER
Director
Fish and Wildlife Service

/s/ Cy Jamison
CY JAMISON
Director
Bureau of Land Management

/s/ Herbert S. Cables
for JAMES M. RIDENOUR
Director
National Park Service

B

Historical Perspective on Northern Spotted Owl Management

Before the early 1970s, relatively little was known about the northern spotted owl except that it resided in a variety of forest types in western Washington, western Oregon, and northwestern California. It was considered a rare or uncommon resident in most of its range (Marshall 1969).

Spotted Owl Research and Planning Before the Endangered Species Act of 1973

Eric Forsman and Richard Reynolds began searching for spotted owls in Oregon during the late 1960s. Their preliminary work revealed that spotted owls were present in several locations, including some areas where Marshall (1942) and Gabrielson and Jewett (1940) had reported owls many years earlier. Forsman and Reynolds brought their findings to the attention of Howard Wight at Oregon State University, who became intrigued by the owl and its association with older forests.

Foreman, then a graduate student, and Howard Wight (unit leader) began research on the northern spotted owl in 1972 at the Cooperative Wildlife Research Unit at Oregon State University. After only a year of research, they became concerned because many of the owl pairs they were finding were in areas slated for timber harvest. They relayed their concerns to the ODFW, FWS, FS, and BLM.

In 1973, Ed Schneegas at the Regional 5 Office of the FS became interested in the issue and initiated the first survey of the spotted owl in California. That study was conducted in 1973-74 by Gordon Gould, later of the California Department of Fish and Game. This study, which demonstrated that the owl was more abundant in California than was previously believed, generated considerable interest in California (Gould 1974).

Oregon Endangered Species Task Force

Publication of a summary reference for compiling the official list of nationally endangered species drew regional and national attention to the spotted owl in 1973, when it was included as a possible candidate for the list. Shortly after that publication was released, John McKean, then Director of the Oregon Game Commission, proposed that a professional interagency task force be formed to address endangered species management in Oregon. This group, the Oregon Endangered Species Task Force, was formed in 1973.

Appendix B: History

At the recommendation of Howard Wight, the Task Force agreed to address the needs of species that used old-growth forests (unpubl. meeting minutes, 1973). The Task Force also agreed that the highest priority should be given to preserving habitat for the spotted owl. The Task Force recommended to State and Federal agencies that 300 acres of old-growth habitat be retained around each spotted owl location interim protection until Statewide guidelines could be adopted within a year. This recommendation was rejected by R6 of the FS and the Oregon State office of the BLM, who wanted a Statewide population management goal to be established before proceeding further. At the time, owls had been located at only about 100 sites in the State.

Spotted Owl Research and Planning After the Endangered Species Act of 1973

The Federal Endangered Species Act, which became law late in 1973, had no immediate effect on spotted owl management, but has served ever since as the yardstick for species protection on public lands. As a result of the Oregon Task Force's work, a State list of threatened and endangered species was submitted to and adopted by the Oregon Wildlife Commission (ODFW 1975). The northern spotted owl was listed as a 'threatened" species on the administrative list, which had no statutory authority at the time.

Research efforts in Oregon and California continued over the next few years (Forsman 1976, Gould 1974). Passage of the National Forest Management Act in 1976 and regulations issued pursuant to that Act laid the groundwork for maintaining well-distributed, viable populations of all native species on National Forests. Later that year, the Task Force recommended a long-range goal of maintaining "...400 palm of spotted owls on public lands in Oregon consistent with the specific habitat requirements of the species." The Task Force also stated that it would "Identify the number of spotted owl habitats and their distribution needed to maintain a viable population throughout their distribution in Oregon." As interim policy, to be followed while the guidelines were being developed, the Task Force recommended that involved agencies "Protect spotted owl sightings and nest sites consistent with the specific habitat requirements as described by Forsman, 1976, and other observers."

First Oregon Spotted Owl Management Plan

Both the Oregon State Director of the BLM and the FS Regional Forester (R6) agreed in early 1977 to protect spotted owl habitat in accordance with Task Force interim recommendations, except where sales under contract or current fiscal year timber sales existed. In late 1977, the Oregon Spotted Owl Management Plan was submitted to the various agency administrators for review and comment. The plan recommended habitat management areas that included clusters of three to six pairs with a minimum of 1200 acres of contiguous habitat per pair. Each pair was to have a core area of at least 300 acres of old growth or the oldest available contiguous habitat, if 300 acres of old growth did not exist. At least 50% of the remaining 900 acres were to be covered by forests older than 30 years. Core areas for clustered pairs of owls were to be no more than 1 mile apart, as measured from center to center. Management areas were to be a maximum of 8 to 12 miles apart for multiple pair habitat areas, less for single pairs. Management areas were allocated based the amount of land administered: FS, 290 pairs; BLM, 90 pairs. State and private ownerships were expected to manage for 20 pairs, although no formal agreement was made by which this plan could be implemented on State or private lands. A major oversight was made in allocating pair numbers to BLM; BLM-administered

lands were actually spread over twice as much area as comparable FS lands (because of the checkerboard pattern of land ownership). The result was that managed owl sites on BLM lands were much more widely spaced than on FS lands.

Both the R6 Regional Forester and the Oregon State Director of BLM agreed to implement the management-plan recommendations through their ongoing land management planning processes. Final decisions on distribution, number, and location of sites managed for owls were to be made with public involvement through the planning process. The year was 1977, 4 years after the Task Force began work on the plan.

Oregon-Washington Spotted Owl Subcommittee

A regional interagency organization, called the Oregon-Washington Interagency Wildlife Committee (OWIWC), was established in 1978 because of the various wildlife issues common to Oregon and Washington. One of the first acts of the OWIWC was to disband the Endangered Species Task Force and replace it with a group of biologists and administrators from Oregon and Washington—the Spotted Owl Subcommittee. In December 1978, the Subcommittee further refined the Oregon Spotted Owl Management plan by addressing the need for managing unprotected pairs, private land owner participation, relocating management areas, and a recommended process for regular plan review.

Increasing Effort

After 1978, the effort expended on owl surveys increased considerably on many National Forests in Oregon and Washington, and in 1979, a Washington Spotted Owl Working Group was initiated. In 1980, the R6 Regional Forester directed National Forests in Washington to protect spotted owl habitat for all confirmed pairs, in accordance with Oregon Spotted Owl Management Plan criteria. In 1981, Washington Forests were further directed to provide protection to 112 pairs, pending issuance of the draft R6 Regional Guide later that year.

Oregon Spotted Owl Plan Revised

In response to radio-telemetry studies by Forsman (1980, 1981), the Spotted Owl Subcommittee revised the 1977 Oregon Spotted Owl Management Plan in 1981 and recommended that 1000 acres of old-growth forest be maintained for each pair within a 1.5-mile radius of the nest area. The 1000-acre figure represented the minimum amount of old growth found within the home ranges of six pairs studied by Forsman and Meslow (1985), and the 1.5-mile radius represented the area within which nesting pairs confined most of their foraging. These recommendations were forwarded to the BLM and FS in Oregon. Region 6 of the Forest Service agreed to the new recommendations only to the extent that they would "maintain the option" to manage for 1000 acres if further research proved it was necessary. The BLM in Oregon continued to protect only 300 acres for managed pairs.

Regional standards and guidelines for the spotted owl (regardless of subspecies) on National Forest lands in California were formulated in 1981. They were modeled after the Oregon Spotted Owl Management Plan, except that the concept of replacement habitat was added. Habitat areas were to contain 1000 acres of the oldest available habitat plus 650 to 1650 acres of replacement habitat. The amount of replacement habitat varied, depending on whether the habitat area was to be fully protected or managed. When possible, owls selected for management were selected in groups of three closely spaced pairs. Implementation started in 1982 under the standards and guidelines identified in the land management planning process.

Appendix B: History

First FWS Status Review

The Portland Regional Office of the FWS undertook a status review of the spotted owl in 1981 because of concerns about the decline of old-growth forest (USDI 1982). Although the species was described as 'vulnerable" in this review, the FWS concluded that the species did not then meet the listing requirements of the Endangered Species Act of 1973.

The Old Growth Wildlife Research and Development Program

The FS, in cooperation with the BLM, initiated the Old Growth Wildlife Research and Development Program in 1982, which addressed species of concern in western Washington and Oregon. (This program was rechartered in 1986 as the Spotted Research, Development, and Application Program and included both the Pacific Northwest and Pacific Southwest Research Stations.) Under the auspices of this program, numerous studies on spotted owls and associated habitats were initiated in Oregon, Washington, and California. These studies are still in progress and have generated numerous progress reports and publications.

BLM-ODFW Agreement

The BLM also issued a proposed decision on their Coos Bay District timber management plan in 1982. The Oregon Fish and Wildlife Commission found that the proposed plan failed to meet State wildlife policies and existing Federal laws, and would not provide sufficient protection for the spotted owl. The Oregon Land Conservation and Development Commission sustained this objection. As a result, BLM and ODFW were requested to negotiate a settlement. The negotiation culminated in a 5-year agreement signed in 1983, in which the two agencies agreed that BLM would manage habitat to maintain a population of 90 pairs of spotted owls, with appropriate distribution of pairs, as a contribution to maintaining a minimum viable population in western Oregon."

Research In Washington

In 1983, WDW began a 3-year cooperative study with the FS to monitor the effectiveness of the proposed FS spotted owl management strategy. This work led to additional studies on home-range size and habitat use.

FS Regional Guide

The FS issued the final Regional Guide (USDA 1984) for the Pacific Northwest Region in 1984. The Regional Guide directed the National Forests to analyze the effects of protecting at least 375 pairs in Oregon and Washington as they developed Forest plans. Management was to follow the 1981 proposed revision of the Oregon Interagency Spotted Owl Management Plan. Shortly thereafter, the R6 Regional Office provided further direction for spacing requirements needed to maintain distributed population. This increased to 551 the number of spotted owl habitat areas proposed for management under Forest plans in Oregon and Washington.

FS SEIS

Later in 1984, a consortium of conservation groups appealed the R6 Regional Guide on the grounds that the standards and guidelines it contained were inadequate, that the proposed plan was a major Federal action requiring an environmental impact statement (EIS). The Chief of the Forest Service denied the appeal, but the Deputy Assistant Secretary for Agriculture reversed that decision and directed the FS to prepare a supplemental EIS (SEIS) on spotted owl standards and guidelines. Preparation of the SEIS began in 1985.

Appendix B: History

FS Standards and Guidelines in California

Several forests had not yet begun by 1984 to implement the Region 5 standards and guidelines that had been issued 2 years earlier because of delays in preparing individual forest land management plans. The CDFG and R5 (FS) agreed that regional standards and guidelines should be implemented promptly before existing owl management options were lost. As a result, a network of spotted owl habitat areas were established on all western Sierra Nevada and northwestern California National Forests.

National Audubon Advisory Panel

The National Audubon Society formed a "blue-ribbon" advisory panel in 1985 to review the status of the spotted owl in Washington, Oregon, and northern California. The panel recommended in 1986 that a minimum of 1500 pairs of spotted owls be maintained in the three States, including in the Sierra Nevada of California, and that much larger amounts of habitat be protected for pairs of owls in the range of the northern subspecies (Dawson et al. 1986). A variation of this recommendation was included as "alternative M" in the spotted owl SEIS being developed at the time by the FS.

After an evaluation of spotted owl management areas, ODFW recommended in 1985 that BLM establish a minimum of 40 additional spotted owl habitat areas. This recommendation was made because many of the 90 sites that BLM was protecting at the time were characterized by poor habitat, scattered distribution, and low occupancy by owls. The BLM did not act on this recommendation until 2 years later, when they agreed to manage for an additional 20 pairs of owls (110 total) that would be jointly selected by BLM and ODFW.

Private Industry Becomes Involved in Research

Private industry became involved in research efforts on spotted owls in 1986 through the National Council for Air and Stream Improvement in Corvallis, Oregon. Since then, industry research efforts have expanded to all three States on both public and private lands.

BLM Environmental Assessment

In 1986, the BLM initiated a Statewide environmental assessment (EA) on the spotted owl in Oregon to determine if new information required a supplemental EIS on their existing timber management plans. After public review, the BLM decided in 1987 that a supplemental EIS was not warranted.

FWS Petitioned to List

The FWS acknowledged in early 1987 that they had received a petition from Greenworld to list the spotted owl as an endangered species under the Endangered Species Act of 1973. A new status review was undertaken and, in December 1987, the FWS announced that listing was not warranted. The decision not to list was appealed to the Seattle Federal Court by conservation groups in 1988. The Court determined that the decision not to list was not biologically based and ordered the FWS to readdress the listing decision.

California's Planning Process

In early 1987, CDFG began filing nonconcurrences with CDF when reviewing timber harvest plans where the cutting of old-growth stands in north coastal California was proposed. By later in the year, environmental groups had brought suit to stop several sales where nonconcurrences had been filed but CDF had approved the sale. This litigation caused a review of the CDF's harvest planning process and of the Board of Forestry rules relating to how sensitive wildlife species are handled.

Appendix B: History

In 1989, the State Legislature passed AB 1580, which directed CDF to develop a system to better track how harvest planning decisions are made, and to develop a scientific data base on timberland habitats and wildlife species so that cumulative impacts of timber harvesting can be better analyzed. At the same time, the Board of Forestry asked CDF to develop a habitat conservation plan so that harvest and logging could continue if the northern spotted owl was listed as a threatened species by the FWS at some future date.

Spotted Owl Listed by States

The Washington Wildlife Commission listed the spotted owl as "endangered" throughout the State in 1988. As a result of the listing, WDW began to develop a State recovery plan with participation by agency and private organizations. That process is ongoing. Late in the year, the Oregon Wildlife Commission, under a new State endangered species act, reaffirmed listing the spotted owl as "threatened" in Oregon. Such a listing requires protection on all State lands but not on private lands. Protection on private forest lands is now being addressed by ODF under recent (1987) amendments to the State Forest Practices Act.

In April 1988, the Interagency Spotted Owl Subcommittee proposed new management guidelines for the northern spotted owl that, for the first time, addressed the entire range of the subspecies in Washington, Oregon, and northern California. The main features of the Spotted Owl Subcommittee recommendations were to maintain larger population centers, protect all remaining habitat in areas of special concern (such as the Oregon Coast Range), regenerate more habitat in problem areas, maintain an interconnecting network of individual SOHAs of one to three pairs per township, retain an amount of habitat per pair that reflected the mean amount of old growth in home ranges of radio-marked pairs, and provide for replacement habitat. Monitoring and coordination were also addressed. These recommendations were acted on by any of the agencies responsible for managing the owl. Since that time, the subcommittee has become inactive.

FWS Proposes Listing Spotted Owl as Threatened

The FWS initiated another status review in January 1989 to supplement the 1987 review. The status review was completed in April, with the result that the northern spotted owl was deemed to warrant protection as a threatened species under the Endangered Species Act of 1973. As a result of this decision, an FWS listing-review team was established in October 1989 to review this proposal and make a final recommendation on whether to list the owl in June 1990. The proposal to list the northern spotted owl triggered requirements that the FS and BLM confer with the FWS under Section 7 of the Endangered Species Act. Interim guidelines were prepared by the FWS to assist the agencies in evaluating timber sales that would impact spotted owls. These guidelines increased the size of SOHAs in northern California to 2000 acres and designated some interim "areas of concern" where timber sales were to be deferred for 1990. This conferencing process is ongoing.

The Scientific Committee Begins

A new interagency agreement was signed in August 1988 by the heads of the BLM, FS, FWS, and NPS. In that agreement, the agencies agreed to work toward a common goal of ensuring population viability for the spotted owl throughout its range. The Interagency Agreement served as the umbrella under which the Interagency Spotted Owl Scientific Committee was formed in 1989.

Appendix B: History

The Final SEIS

In late 1988, the Chief of the FS issued a Record of Decision on the supplemental spotted owl EIS for Oregon and Washington. The selected alternative (F) directed the 13 National Forests with spotted owls to establish a SOHA network. Standards and guidelines differed for physiographic provinces. Amounts of habitat to be provided in SOHAs varied from 1000 acres in southern Oregon to 3000 acres on the Olympic Peninsula. Habitat was to be identified within 1.5 miles of the center area in Oregon and 2.1 miles in Washington; SOHAs containing three or more pairs were to be no more than 12 miles apart, and single-pair SOHAs were to be no more than 6 miles apart. The Record of Decision was shortly appealed by WDW and by timber and environmental groups, but the Assistant Secretary of Agriculture denied the appeals.

The Hatfield-Adams Amendment

Interest groups obtained injunctions prohibiting the sale of old growth on BLM lands near spotted owl sites, and continuous litigation finally resulted in the "Northwest Compromise" (Hatfield-Adams Amendment) of 1989. This legislation applied to Washington and Oregon, and was attached as a rider (Section 318) to the 1990 fiscal-year appropriations bill. It declared the FS's Spotted Owl SEIS and the BLM's spotted owl management plans adequate for preparing FY90 sales. The compromise expanded FS SOHA sizes by 12 to 25% and established 12 new agreement areas on BLM lands, for a period of 1 year. It also instructed the FS and the BLM to minimize the fragmentation of "ecologically significant" stands of old growth in Oregon and Washington and provided for establishing citizen advisory boards to assist the FS and BLM in preparing and modifying sales. Implementation of Section 318 is ongoing.

Committee Established

As a result of the uncertainty surrounding the status of the northern spotted owl, the FS recommended the formation of an interagency scientific committee to address the issue. This recommendation was agreed upon by the heads of the BLM, FS, FWS, and NPS, and in October 1989, the interagency Spotted Owl Scientific Committee was established. The charge to the Committee was to "develop a scientifically credible conservation strategy for the northern spotted owl." The task was essentially completed with the publication of this document.

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C

The Current Situation

Description

The spotted owl *(Strix occidentalis)* is a medium-sized bird with a round head, dark-brown plumage, and dark eyes. It has white spots on the head and nape, and white mottling on the breast and abdomen; thus the name "spotted owl". Sexes look alike except that females average slightly larger and have higher pitched calls than males. A distinctive feature of spotted owls is their unwary behavior around humans, often allowing human observers to approach within a few feet before flying (USDA 1988a). Prey consists mainly of small mammals, particularly arboreal or semi-arboreal species, although birds, insects, and other types of small mammals are taken as well (see appendix J). Flying squirrels, woodrats, and lagomorphs (rabbits and hares) are especially important.

The only species with which spotted owls might be confused is the closely related barred owl *(Strix varia).* Barred owls are slightly larger than spotted owls and have a distinct pattern of horizontal bars on the breast and vertical streaks on the abdomen. Unlike spotted owls, barred owls are wary and usually fly away when approached. The barred owl has invaded the Pacific Northwest and northern California in recent years and appears to be displacing spotted owls in some areas (Grant 1966 in USDA 1988a, Taylor and Forsman 1976).

Current Taxonomy

Recent studies of genetic differences among spotted owls over much of their range in the Western United States showed essentially no genetic difference between the northern *(Strix occidentalis caurina)* and California subspecies *(S. o. occidentalis).* but a gene substitution was found between the California and Mexican subspecies (S. *o. lucida)* (Gutiérrez 1989). Barrowclough (pers. comm.) identified several morphological features that exhibit clinical variation from north to south across the range of the northern and California subspecies. In considering the significance of these results at their annual meeting in August 1989, the Committee on Classification and Nomenclature of the American Ornithologists' Union ruled that the northern and California subspecies would be retained as originally described (Johnson 1989). The rationale behind the decision follows a standard used in similar cases reviewed by the taxonomy committee in recent years. If a species exhibits clinal variation across its range, the ends of the cline are judged to be sufficiently distinct to be recognized as separate subspecies.

A decision about where to place the boundary between the two subspecies is based, at least in part, on geographic and biogeographic considerations. For the spotted owl, the Pit River in northern California was originally designated as the boundary. Because this coincides with other known subspecific boundaries of vertebrates, it was retained for these subspecies of spotted owl. Thus, no change of any kind was made in the taxonomy of spotted owls.

Appendix C: Current Situation

Status

The need to devote special management attention to a species is conveyed by Federal and State regulations classifying the species according to the perceived attention needed. This classification is accomplished by enabling legislation dealing with threatened and endangered species. In addition to receiving protection under the Migratory Bird Treaty Act of 1918, the northern spotted owl is currently on classification lists maintained by the Federal government and by each of the three States within its geographic range. Under the Endangered Species Act of 1973, as amended, the northern spotted owl is currently proposed for Federal listing as a threatened species. A decision on whether to add it to the Federal threatened-species list will be forth-coming from the FWS in summer 1990. In Washington, the northern spotted owl is classified as endangered, in Oregon as threatened, and in California as a species of special concern. Its classification in California is an administrative action of the Fish and Game Department and not a product of regulations as with the other two States.

Until its recent Federal classification as a proposed threatened species, the spotted owl was provided additional recognition by FS policy, which classified it as a sensitive species. This classification brought into play a set of agency regulations and actions designed to direct specific attention to the spotted owl. The BLM's classification of the spotted owl as a special status species provides similar agency attention. Finally, the spotted owl has been designated an indicator species for old-growth forest ecosystems on all National Forests within its range.

Range

The present range of the spotted owl approximates the limits of its historic range (fig. C1). The range encompasses an area from southwestern British Columbia south through the coastal mountains arid Cascade Range (both west and east sides) of Washington and Oregon, south into southwestern Oregon and northwestern California north of San Francisco. Note that although the subspecies' range has not decreased, its distribution within the range has. Of particular note are the Puget Trough in Washington and lands adjacent to the Willamette Valley in Oregon. Both of these areas have undergone significant changes in habitat for spotted owls because of human development and thus no longer support populations of owls. Similar, but less complete habitat changes have negatively affected owl distribution in southwestern Washington and northwestern Oregon. Here, timber cutting and wildfires have played a major role. Spotted owl populations in these areas are low at present. In British Columbia, fewer than 20 pairs are known to exist; much of the owl's range in Canada has been logged, and little mature and old-growth forest remains.

Appendix C: Current Situation

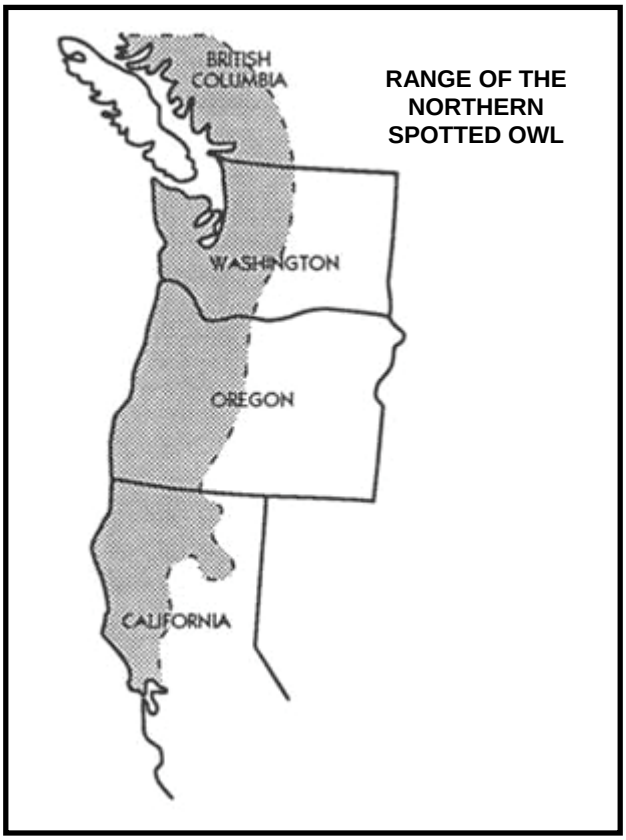

Figure C1—Range of the northern spotted owl.

Physiographic Provinces

Because of the extent of the owl's range, we subdivided it into smaller areas for practical and analytical purposes. Studies have shown differences in numbers, distribution, and habitat-use patterns of the spotted owl relative to various forest zones that occur within its range (for example, western hemlock versus mixed-conifer) (appendices F, I, and J). These forest zones and their inherent plant communities are products of the effects of climate and geology on the landscape. Physiographic provinces (Franklin and Dyrness 1988) provided a recognized set of landscape subdivisions incorporating the physical and environmental factors that shape the landscape of the Pacific Northwest. These physiographic provinces were modified and used as the first subdivision of the range of the spotted owl (fig. C2).

Appendix C: Current Situation

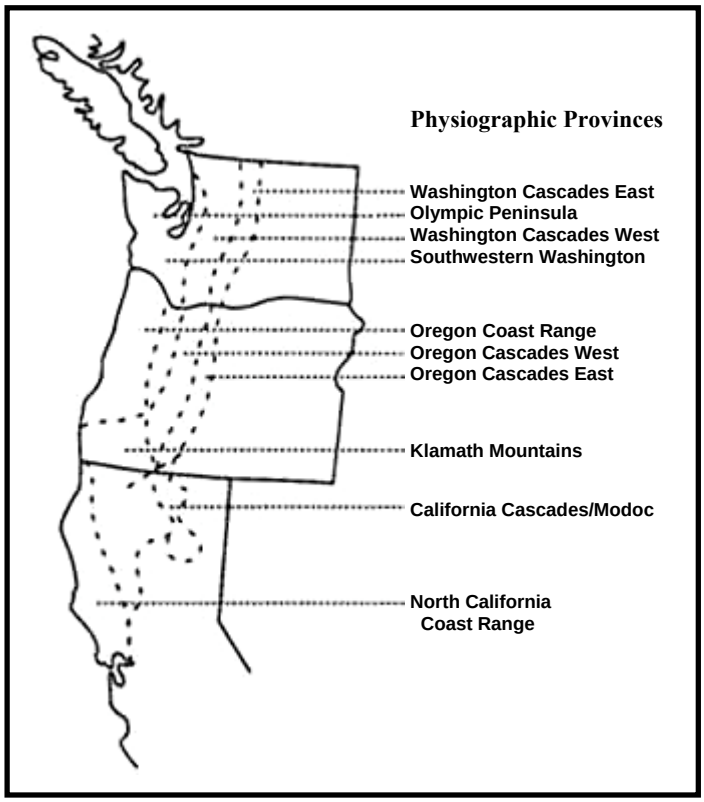

Figure C2—Physiographic provinces within the range of the northern spotted owl.

Habitat

A general characterization of the forested habitat in specific forest types used by spotted owls includes the following attributes (see details in appendices F, G, and H): Large, tall, live trees with cavities, broken tops, dwarfmistletoe, or platforms of branches capable of holding accumulated organic matter suitable for use as a nest; dead standing trees and fallen, decaying trees and limbs to support abundant populations of prey species, especially northern flying squirrels and woodrats; dominant trees in the stand with relatively large diameters; and multilayered tree canopies with a moderate to high canopy closure in overstory, midstory, and understory.

A consensus among spotted owl authorities holds that structure is a more important factor in determining suitability for owls than tree age. Older forests, however, more often exhibit the structural attributes favored by owls than do younger ones.

The total amount of spotted owl habitat has been declining since European settlers arrived in the 1800s (USDA 1989). We do not know the full extent of owl habitat before 1800, but estimates of about 17.5 million acres in 1800 and 7.1 million acres today indicate a reduction of about 60% in the past 190 years (USDA 1989). Most of this reduction has occurred in the last 90 years. Current trends indicate annual reductions of about 1 to 2% of remaining suitable habitat on National Forests.

Appendix C: Current Situation

Remaining suitable owl habitat is not evenly distributed over the range of the species. Habitat reduction has been concentrated at low elevations and in the Coast Range, a fact mirrored by the low populations of spotted owls in those areas. The quality of remaining habitat at high elevations may not be as good as it was in those low elevation lands that no longer support owls (see appendices F, G, and H). This lack of quality may be particularly true of the 40% of the estimated remaining habitat now in reserved areas or in areas unsuited for timber production, which are commonly located at higher elevations.

Most of the remaining suitable habitat is found on Federal lands (about 94% of the acreage figures available); the FS manages about 74% of these lands; the BLM about 12%, and the NPS about 8%. Percentages may change as habitat inventories are expanded in northern California, where a significant portion of spotted owl habitat may be on private lands, especially along the Coast Range (west of National Forest lands). Gould (pers. comm.) estimates that as much as 40% of northern spotted owl habitat in California could be on private lands. In Oregon and Washington, however, more than 95% of the estimated acreage of owl habitat is found on federally managed lands.

Population Status and Trend

No estimates have been made of the historical population size of the spotted owl, and few data are available on its historical distribution. Spotted owls are believed to have inhabited most old-growth forests throughout the Pacific Northwest and northwestern California, and they are still found within their historical range in most areas where such habitat remains (USDI 1989a).

Northern Washington and southern British Columbia represent the northern extent of the range of the northern subspecies. Population densities and numbers are lowest in these areas, with less than 20 pairs located in recent extensive surveys along the U.S. border in British Columbia (Dunbar, pers. comm.). A small, potentially isolated population of perhaps 110 pairs of spotted owls lives on the Olympic Peninsula in an area in and around the Olympic National Park (Fredrickson et al. 1989, WDW 1990). Fewer than 40 owls have been found in recent, extensive surveys in the Coast Ranges of southwestern Washington and northwestern Oregon north of Corvallis (Forsman 1986; Forsman et al. 1987; Irwin et al. 1989a, ODFW 1990; USDI 1989a) (see appendix G). The population also decreases in size and density from the Mendocino National Forest south to Point Reyes, California, as well as from the Klamath Province east to the intersection with the California subspecies in the Sierra Nevada (Gould, pers. comm.; USDA 1989).

Most of the present owl population is found from the southern portion of the Cascades in Washington southward, throughout the Cascades and Klamath Provinces in Oregon, and into the Klamath and Coast Range Provinces in northwestern California (see fig. C2) (Advanced Sci. 1989, Beak Cons. 1989, Brown 1989, Diller 1989, Irwin et al. 1989b, Kems 1989, ODFW 1990, Pious 1989, USDA 1989, WDW 1990). Distribution of remaining habitat is similar to the present distribution of spotted owls (see table C1 and discussion on habitat status).

Appendix C: Current Situation

Over 90% of the known pairs of owls have been observed on federally managed lands—68% on FS lands and 22% on BLM lands. The distribution of these pairs varies widely by land ownership, State, and physiographic province (see table C1). Distribution is particularly important in California, where up to 40% of the habitat could occur on private lands. Although inventories are less complete in California, about 30% of the habitat and population of spotted owls may occur in the Coast Range (Gould, pers. comm.; Self, pers. comm.).

Observations of spotted owl pairs have accumulated for almost 20 years. These counts have been cumulatively tallied over this period as additional and more intensive surveys have been done, particularly in the past 3 years. Censusing is not complete because not all suitable habitat has been fully surveyed. In addition, counts have not accounted for differing inventory intensities, sites lost through habitat reduction or conversion, loss and recolonization of sites by new or displaced pairs, sites found through recent inventories, or double counting the same pairs in different sites. This type of information is not a good indicator of true population size or trend.

Cumulative numbers of owl pairs observed over their range during the past 5 years (table C1) include estimates of both breeding and nonbreeding pairs. The past 5-year period (1985 to 1989) was chosen because we consider it to be a more reliable estimate of actual numbers than a longer cumulative period or any single-year count, given the current habitat situation. It is the period with the most intense inventories, and it is within the average life span of the species (about 8 years), so it should provide a reasonable balance between how recent habitat loss has affected owl survival and occupancy of sites, and an attempt to report a correct count of pairs, given some of the problems noted above.

A total population estimate was not made. Data from the inventories done during the 5-year period indicate a total of about 2000 known pairs of spotted owls in Washington, Oregon, and northern California. This number is a minimum estimate of the true population size. We suspect the true number lies somewhere between 3000 and 4000 pairs.

Population size is primarily a function of the total amount, distribution, and suitability of habitat available to sustain successfully reproducing owl pairs through time. Present analyses indicate that the population of spotted owls is declining because of habitat loss and modification, and the rate is similar to the decline of suitable habitat (see appendix L).

Appendix C: Current Situation

Table C1--Estimated acres of spotted owl habitat and number of pairs of spotted owls located in the last 5 years on all lands in Washington, Oregon, and California (NA=reliable estimates not available)

Land Owner or agency[a]	Estimated acres of spotted owl habitat timber capability				Owl pairs		
	Reserved[b]	Unsuitable[c]	Suitable	Total acres	Repro-ducing	Not re-producing	Total
FS, WA	433,000	384,000	818,000	1,635,000	166	151	317
FS, OR	438,000	241,000	1,909,000	2,588,000	274	393	667
FS, CA	151,000	209,000	474,000	834,000	169	234	403
BLM, WA	NA	NA	NA	—	—	—	—
BLM, OR	158,000[d]	—	701,000	859,000	224	207	431
BLM, CA	13,000	—	6,000	19,000	7	7	14
NPS, WA	480,000	0	0	480,000	10	10	20
NPS, OR	50,000	0	0	50,000	2	3	5
NPS, CA	40,000	0	0	40,000	1	2	3
Tribal lands, WA	42,000	NA	24,000	66,000	2	3	5
Tribal lands, OR	NA	NA	NA	54,000[e]	1	0	1
Tribal lands, CA	NA	NA	NA	NA	NA	NA	NA
FWS, WA	1,700	NA	5,000	6,700	0	1	1
FWS, OR	4,100	NA	NA	4,100	0	0	0
WDNR, WA	NA	NA	NA	NA	4	9	13
WDW, WA	0	NA	5,000	5,000	0	0	0
State Parks, WA	2,000	0	0	2,000	0	0	0
Cities of Seattle, Tacoma	0	0	1,500[f]	1,500	0	0	0
ODF	2,000	NA	78,000	80,000	1	2	3
State Parks, OR	8,000	0	0	8,000	1	0	1
Counties and cities, OR	NA	NA	NA	NA	1	0	1
CDF	NA	NA	NA	NA	0	3	3
State Parks, CA	56,000	0	0	56,000	5	3	8
State Lands Comm., CA	NA	NA	NA	NA	NA	NA	NA
BLM/TNC, CA	6,500	0	0	6,500	0	2	2
NAS, CA	600	0	0	600	0	1	1
Private, CA	NA	NA	NA	NA	36	63	99
Private, OR	NA	NA	NA	NA	NA	NA	20
Private, WA	NA	NA	NA	NA	2	2	4
Totals	1,885,900	834,000	4,021,500	6,795,400	906	1,096	2,022

[a] See text for sources of above information.
[b] Withdrawn from Umber harvest (that is, Wilderness and Research Natural Areas).
[c] Lands unsuited for Umber production because of allocation to other uses by land management plans, or technically unsuited for timber production because of soils problems or difficulty of regeneration.

Appendix C: Current Situation

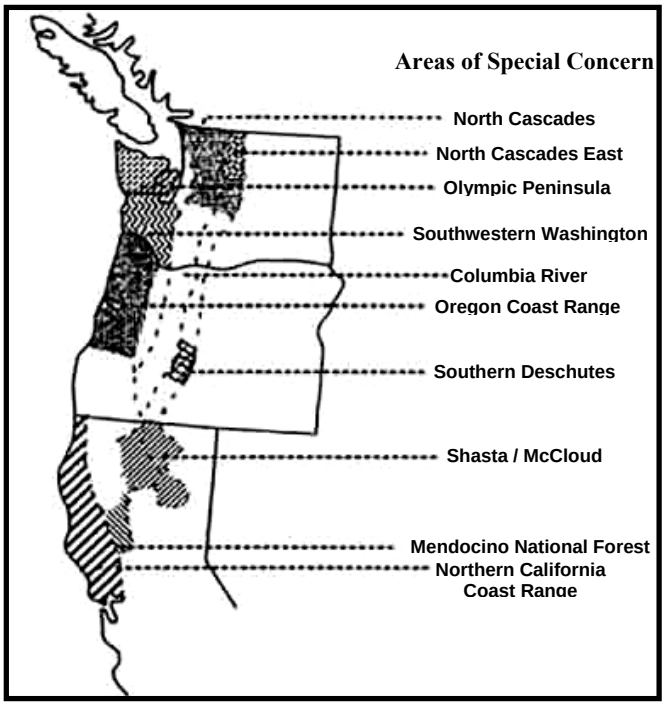

Figure 03—Areas of Special Concern for management of the northern spotted owl.

Areas of Special Concern

As a result of both natural and human-related activities, all lands in a physiographic province are not the same in quantity and quality of spotted owl habitat. A primary difference is the ownership pattern, which results in an array of land treatments that either retained or eliminated owl habitat to different degrees. Natural events such as large wildfires and volcanic eruptions sometimes have played a major role in shaping habitat conditions. To address these differences, the physiographic provinces were further subdivided by identifying "areas of special concern." These areas—lands where past natural occurrences and human actions have adversely affected habitat more than in the remainder of the province—are discussed individually below (see fig. C3 for locations).

North Cascades

Spotted owls in the Washington Cascades are a special concern because of the likelihood of demographic isolation from populations in Oregon and the Olympic Peninsula, and because of the low numbers of known pairs in that region. Federal ownership is primarily at intermediate and high elevations (2000 to 14,000 feet), where mountainous areas serve as potential barriers to owl distribution and dispersal.

Of particular concern is the northern Washington Cascades, encompassing areas north and northeast of Mount Rainier and the Goat Rocks Wilderness to the Canadian border. Much of the existing and potential owl habitat on Federal lands within this area resembles forested fingers, bordered by steep-walled canyons and high, subalpine ridges. Logging of State, private, and Federal lands has moved inexorably

from sea level to gently sloped areas, and now encroaches on the steep mountainous terrain of the interior Cascade Range. The gently sloped areas from sea level to about 2000 feet, now primarily under private and State ownership, probably once provided relatively contiguous tracts of habitat supporting high owl densities.

North Cascades East

In Okanogan County and the northern portion of Chelan County, owl pairs are known in only six locations, marking the northern-most distribution of the subspecies in the eastern Cascades of Washington.

Olympic Peninsula

We believe the spotted owl population on the Olympic Peninsula is now demographically isolated from the Cascade Range by a span of intensively managed State and private forest lands more than 60 miles wide. Spotted owls on the Peninsula live in Olympic National Park, Olympic National Forest, State lands managed by the Department of Natural Resources, and private lands. Isolation of a population of fewer than 150 pairs increases the risk of extirpation, thus the concern about owls in this region.

Southwestern Washington

Only one pair of owls is known in southwestern Washington, a large area of private and State forest that separates the Olympic Peninsula from the Cascade Range. Most lands in this block are intensively managed for timber production using 50- to 70-year rotations. No regulatory mechanisms or management plans are currently in place that will either protect existing owls or provide for future spotted owl habitat within the area.

Columbia River

Bisection of the Cascade Range by the Columbia River Gorge has caused concern that this geologic feature, plus the associated effects of human activities along the river, have created a barrier to the movement of spotted owls between the Washington Cascade Province and the Oregon Cascade Province. Spotted owl habitat in this area now occurs mainly on the Gifford Pinchot National Forest in Washington and the Mount Hood National Forest in Oregon. Hydroelectric dams along the Columbia River have created impoundments that have widened the river. Highways and land-use patterns along the river in both States have further reduced the amount of suitable habitat immediately adjacent to the river. These patterns create a barrier that could either block or restrict owl movement between the Gifford Pinchot and Mount Hood National Forests. The effects of such a barrier are discussed in appendices N and P.

Recent establishment of the Columbia River National Scenic Area, and FS land acquisitions in the same region, will likely prevent further development of the area and could improve dispersal habitat for spotted owls.

Oregon Coast Range

The area of special concern identified in the Coast Range Province of Oregon includes all forested lands north of State Highway 38 and west of Interstate 5 to the Columbia River, a forested land area of about 4.1 million acres. Within this area, the known owl population is extremely low compared to other areas in the State. Existing data indicate 102 known pairs of spotted owls in the entire area, a density of only 0.015 pairs per square mile. This density is only 1/8 that recorded in a study area in the Coast Range outside the area of concern. This low density parallels an equally dire scarcity of suitable owl habitat. Most of the forest is <BO years old. The remaining areas of older forest are scattered across the landscape, and are becoming increasingly isolated.

Appendix C: Current Situation

Southern Deschutes

The area of concern in the Deschutes National Forest, south of Bend, Oregon, is at the eastern edge of the species' range. Because of the disjunct nature of the mixed-conifer forests there, and the patches of habitat that are becoming more isolated, risk to the owl population is high. We believe, however, that maintaining as wide a distribution as possible of occupied plant community associations throughout the range of the spotted owl is important to minimize the impact of potential catastrophic effects (see appendices N and O) and to maintain genetic variability.

Shasta-McCloud Area

The Shasta-McCloud area includes the Shasta portion of the Shasta-Trinity National Forest, as well as eastern parts of the Salmon River and Scott River Ranger Districts and all of the Goosenest Ranger District of the Klamath National Forest. The north Coast Range creates a rain shadow on its east side and beyond. Although this area includes forest, site quality is poor because of the drier, warmer climate and poor soils (for example, extensive areas of old lava flows). Pine forests commonly lack the multiple canopies and other structural attributes that would render them suitable for spotted owls. Areas of suitable habitat are limited in distribution and fragmented where they occur. Much of this area, especially near McCloud, has also been subject to a long history of logging, further reducing the current amount of suitable habitat.

North Coastal California

North coastal California extends southward from the Oregon border through Main County and to the west of National Forest lands, encompassing major portions of the redwood forest zone that are mostly under private ownership. Except for two National Parks and a BLM Wilderness Area, most public land is in small, scattered parcels. The major problem in this area is administering a Federal habitat conservation plan where success and the viability of the subspecies depend on private and State lands. The California Resources Agency (CRA) has assured us that it is actively proceeding with development of a California Habitat Conservation Plan that will address management of the owl on private and State lands. For this particular area, the success of the conservation strategy proposed in our report depends on prompt drafting and implementing of an appropriate plan for California. Because of the combination of competent professional attention to spotted owls by the timber industry in northern California, the mandates of State law, the leadership potential of the CRA, and the high-site timber lands that contain owls in second growth, we believe that an effective plan can be developed and implemented.

Mendocino National Forest

The Mendocino National Forest south of the Yolla Bolly Wilderness Area, and to some extent, the Covelo Ranger District, are considerably different from National Forests farther north. Forested habitat is more naturally fragmented and becomes even more so towards the southern end of the Mendocino National Forest. An area of true fir grows at elevations around 6000 feet along the north-south ridge in the middle of the Forest. East of this ridge, and in the southwest quarter of the Forest, conditions are drier and warmer. Extensive brush fields occur on south-facing slopes, and suitable habitat often exists only on north-facing slopes.

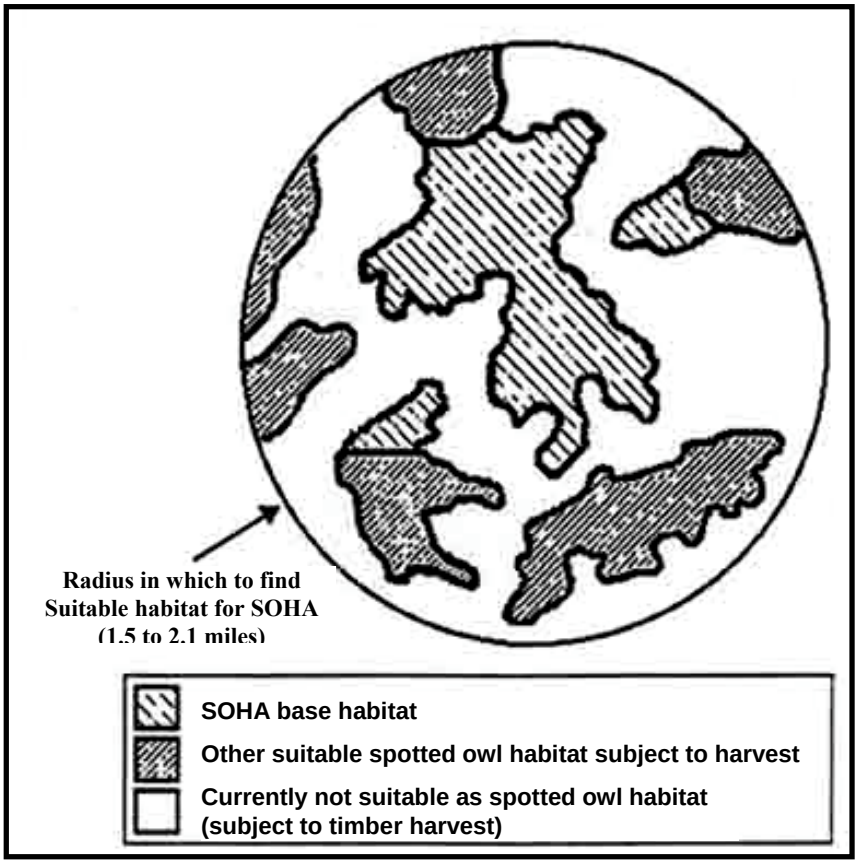

Figure C4—Schematic of a spotted owl habitat area (SOHA) on National Forests in Oregon and Washington.

The Current Management Situation

The FS, Pacific Northwest Region (Washington and Oregon)

Spotted owls occur on 13 National Forests ("owl" Forests) in Oregon and Washington (USDA 1 988a). Each Forest has developed descriptions characterizing owl habitats that might be termed "typical." These descriptions are narrower than the general description in the "habitat" section of this appendix, and debate continues about the full range of suitable owl habitat in the Pacific Northwest Region (see appendices F, G, and H). Further confusion arises because Forests are usually limited to mapping habitat based on data generated for timber management. Substantial variation in the arrangement of habitat occurs depending on past harvest activities, land ownership patterns, and catastrophic events. Patches of habitat ranging from <10 acres to a matrix of relatively contiguous parcels of several thousand acres (usually found in wilderness or roadless recreation areas) occur on National Forests (table C1).

Management direction—Management direction for spotted owls on National Forests in the Pacific Northwest Region (Chief's Record of Decision 1988) has resulted in the designation of 376 Spotted Owl Habitat Acres (SOHAB) ranging from 1000 acres of suitable habitat in southern Oregon to 3000 acres on the Olympic National Forest in Washington (fig. C4). Language in Section 318 of Public Law 101-121 increased the sizes of SOHAs by as much as 25% for 1 year. To be considered a "designated SOHA," the area must have been at least partially on lands suited for timber production (that is, SOHAs were not delineated on maps in Wilderness Areas, other reserved lands, or lands classified as unsuitable for timber harvest). Forests were allowed the option of dedicating SOHA acreages or developing a silvicultural management strategy that would continually provide the prescribed acreages of

Appendix C: Current Situation

suitable owl habitat. Forests with completed land-management plans have opted for dedication. The decision is not final on the other Forests, although all have chosen dedication as interim direction. Flexibility to locate and refine boundaries was also allowed until the final Forest plans were completed (USDA 1989). The standards and guidelines used to establish the networks of SOHAs are contained in Amendment 1 to the Regional Guide for the Pacific Northwest Region, May 1984. This management plan is now being litigated in Federal Courts in Oregon and Washington by forest industry groups, who charge that the network is unnecessary, and by environmental organizations, who contend that it is inadequate to ensure the continued existence of the spotted owl.

The SOHAs, along with existing habitat in Wilderness Areas and areas allocated to uses other than timber production, constitute a network of spotted owl habitat. About 2,024,400 acres of suitable habitat are included. This acreage represents about 16% of all forested land on owl Forests and about 48% of the remaining habitat. Wilderness Areas and lands allocated to uses other than timber production account for nearly 3/4 of the total acreage in the network. Spotted owl surveys have not been done in the Wilderness Areas as frequently or thoroughly as on other National Forest lands. As a result, owl occupancy in these areas is not well known. Amount and arrangements of suitable owl habitat indicate that from 2 to 15 pairs probably occur in each of the various Wilderness Areas, with an average area probably capable of supporting about S pairs.

Before 1989, owls were primarily surveyed in areas proposed for inclusion in the SOHA network. Some Forests conducted limited surveys in timber-sale areas. Beginning in 1989, however, a standardized survey effort was initiated by the Regional Forester to locate spotted owls in proposed timber sales. This standard included visiting the sale area at least three times at night and conducting follow-up, daytime visits to determine pair and reproductive status if owls were seen or heard at night.

Management strategies for owl pairs found outside the network differs from Forest to Forest. When they are located in areas to be logged, strategies range from seasonal protection of a nesting area to protection of 5 to 30 acres around the nest area or center of activity (see appendices C and D).

The major impact on owl habitat on National Forest lands comes from logging. About 64,000 acres per year have been cut in Washington and Oregon in the last 9 years (Nunan, pers. comm.). This amount represents a 1.5% reduction per year in the total amount of spotted owl habitat on National Forests. As the base amount of habitat declines, this annual percentage would increase. The Forest Land Management Plans for the Okanogan and Siskiyou National Forests, and draft plans for the other 11 owl Forests in the Pacific Northwest Region, provide for annual logging averaging about 39,400 acres per year.

Appendix C: Current Situation

Present rates of habitat loss will theoretically decline as Forest land-management plans are completed and implemented, assuming that harvest rates are established in line with land management plans. Logging units, usually clearcuts (up to 80 acres), are laid out in a patchwork pattern across the landscape to meet the dispersion requirements of the National Forest Management Act of 1976. This pattern results in older forest stands becoming less contiguous—that is, more fragmented. As the patches of suitable habitat become smaller and more widely separated, their use by the birds diminishes (see appendix H). Spatial arrangement of habitat is thus a factor that must be considered along with total amounts of habitat, when habitat attributes and trends are assessed (appendices N and O).

The total population of spotted owls is expected to continue to decline as habitat declines (USDA 1988a). Additionally, as older forest stands around SOHAs are logged, the SOHA's ability to maintain reproductive pairs is expected to decline. The Final Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide (USDA 1988a) indicates that SOHAs, if they reach lull target size, are expected to be occupied by pairs 50 to 60% of the time in the future. Olympic National Forest SOHAs were an exception. There, because of larger SOHA sizes, a future occupancy rate of about 85% is predicted. More specific information about expected habitat and population trends can be found in the Final Supplement.

To ascertain whether the network system for spotted owls is functioning adequately, the FS in the Pacific Northwest and Pacific Southwest Regions initiated a research, development, and application program. One of its goals is a monitoring program with two major objectives. The first objective is to track the trend in total owl population. A set of random sample areas (RSAs) of 1000 acres each was selected that is visited each year to determine whether any owl is present, or if pairs are present and if they are breeding. The Final Supplement (USDA 1988a) projected that the population would decline at a rate of about 0.7% per year for the selected alternative. In the Pacific Northwest Region, information collected from the random survey areas is designed to check the validity of that assumption.

The other major objective is to evaluate the ability of SOHAs to maintain breeding pairs of spotted owls. A subset of SOHAs was randomly selected to be visited annually to determine the presence of owls, and their pair and reproductive status. The purpose is to check assumptions in the Final Supplement on the number of the SOHAs that should be occupied by pairs at any point in time. Methods used to determine owl occurrences in SOHAs and random sample areas are strictly prescribed in a Monitoring and Inventory Handbook (USDA 1988b).

Beginning in 1989, an effort to inventory the larger patches of spotted owl habitat in Wilderness Areas was also initiated through the research, development, and application program. Other relationships between owls and their habitat are also being investigated as a result of data collected in the monitoring and inventory program.

Detailed results of the monitoring and inventory programs for the Pacific Northwest Region are available from the Regional Office in Portland and are also compiled in the FS Report to the FWS (USDA 1989). A brief summary follows.

Appendix C: Current Situation

Monitoring—The RSAs have been monitored for only 2 years (1988 and 1989). Although we cannot put much weight on such a limited data set, results showed a slight increase in occupancy by pairs from 1988 to 1989, but they also indicated a slight decrease in the number of reproductive pairs (USDA 1989). They also showed a slight decrease in the presence of any owls in RSAs on lands available for timber harvest, and a slight increase in owl presence on lands not available for timber harvest.

The relation between the amounts of suitable spotted owl habitat and owl occupancy was also analyzed. Data indicated a significant positive relation between the amount of suitable habitat and owl occupancy in RSAs (USDA 1989). That is, areas with more suitable habitat were more likely to be occupied by owls. A similar analysis showed the relation of amounts of habitat and owl occupancy for SOHAs was not significant (see appendix K).

Data collected in 1989 indicate that 92% of the SOHAs had at least one spotted owl (USDA 1989), 62% had pairs, and 35% had pairs with documented reproduction. If 2 years of data are combined for 1988 and 1989, about 97% of the SOHAs had at least one owl, 77% had pairs, and 54% had pairs that were reproductive in at least 1 of the 2 years.

Inventory—Inventory has continued as part of the research, development, and application program since its inception. The Okanogan and Wenatchee National Forests conducted inventories designed to locate as many owls as possible to aid in establishing SOHAs. This work was completed in 1987 on the Wenatchee and in 1988 on the Okanogan. In 1989, inventory of SOHA-sized patches of habitat in Wilderness Areas and roadless areas resulted in detection of at least one spotted owl in 35 of 45 areas surveyed; 18 sites had pairs; and reproductive pairs were found in 10 sites.

Surveys for owls in areas of proposed timber sales, although not a formal part of the monitoring and inventory program, located additional sites occupied by owls. Numbers of spotted owl pairs and singles in the FS report to the FWS (USDA 1989) are cumulative totals found as a result of monitoring, inventories, and surveys for the last 10 years. Many sites have not been visited for 3 to 5 years, however, so we do not know if a given site remains capable of supporting owls. Neither can we determine the extent of double-counting of birds in different locations. Numbers of pairs reported in table C1 are the cumulative totals based on the last 5 years.

Assessment of current management—Acreages prescribed for SOHAs in the Pacific Northwest Region, even with the Section 318 additions, are significantly smaller than average or median amounts of suitable habitat in annual home ranges of pairs described in the literature (see appendix I). About 20% of the SOHAs in the Region lack sufficient suitable habitat to comply with existing direction even before Section 318 called for additions (USDA 1989).

Appendix C: Current Situation

The current strategy's rationale for selecting smaller SOHAs was based on the assumption that acreages of owl habitat would continue to exist close to SOHAs. The Chief's Record of Decision (1988) said that "Sufficient options will remain at that time [in 5 years] to adjust the course of managing spotted owls and their habitats." Our interviews with FS personnel indicate that this assumption is likely invalid in many places (see appendix D). For the 20% of the SOHAs that lack even the prescribed acreage, obviously no options exist. Further, an assessment of habitat maps supplied by the agency indicates that many SOHAs are located where current options to adjust management are extremely limited. Other areas retain some flexibility, but continued logging will quickly restrict the ability to increase sizes and numbers of SOHAs. Although total acreages of habitat may remain high in the next 5 to 10 years, as indicated in analyses contained in the Final Supplement (USDA 1988a), much of that habitat will not be uniformly distributed. In short, owl habitat in the areas of greatest concern will continue to decline precipitously in quantity and quality.

Standards and guidelines for establishing the spotted owl network in the Pacific Northwest Region were designed to maintain owl viability with the least possible impact on the economies of Oregon and Washington (Chief's Record of Decision 1988). The attempt to balance the biological and economic aspects of the standards and guidelines resulted in a high degree of dependence on lands already protected from timber harvest. Occupancy by owls in these areas was often unknown. Restrictions controlling the proximity (usually no closer than 6 miles) of SOHAs to Wildemess Areas, National Park boundaries, or Forest boundaries caused some sites occupied by pairs to be passed over and a site of lesser quality to be selected. This strategy also had the effect of holding down the total number of SOHAs. It also significantly reduced the biological effectiveness of the original concept.

Because suitable habitat often exists as fragmented patches, selection of forest stands resulted in SOHAs with patchy configurations (fig. C4). Spaces between the patches of suitable habitat are often younger, previously harvested forest stands or natural stands where key structural components of owl habitat are absent. These intervening forest stands remain available for timber production. This strategy results in the perpetuation of fragmented, patchy SOHAs. In time, a prescription allowing the intervening areas to become suitable habitat would have resulted in more homogeneous SOHAs that would reduce the risk of blowdown and catastrophic loss, and would perhaps afford greater security for owl pairs in SOHAs.

We believe a primary strategy of managing for spotted owls by providing habitat areas for single pairs, or even two to three pairs of owls, results in an unacceptable risk to the population (see appendices N, 0, and P). "Trigger points" have not yet been identified whereby results from monitoring or research would indicate a need to change management direction. Furthermore, we strongly doubt whether the current approach to monitoring in SOHAs will permit the identification of such trigger points in time to avert the extinction of the northern spotted owl, because of the lag effects in measures of true population decline (see appendix M) and the packing phenomena which typically accompany the gradual elimination of a species' habitat (see appendices M and N).

Appendix C: Current Situation

The FS, Pacific Southwest Region (California)

Pairs of spotted owls have been located on four National Forests in northern California—Six Rivers, Shasta-Trinity, Klamath, and Mendocino. A few individuals have been sighted on the western border of the Modoc National Forest, but no pairs have been verified there. No management direction for owls has been prescribed on the Modoc, and it is not considered to be an owl Forest.

The general description of spotted owl habitat in the Pacific Southwest Region is similar to that in the Pacific Northwest Region (appendix F). In practice, however, mapping of habitat has apparently been based on a more restrictive definition in the Pacific Southwest than in the Pacific Northwest Region. Much uncertainty exists about what forest types are being used by owls (see appendix F). As this understanding improves, current estimates of suitable-habitat acreage in California (table C1) will likely be increased in some locations.

Arrangement of habitat varies by geographic location and, as in Oregon and Washington, reflects past logging activities, land ownership, catastrophes, and local site conditions. In some locations, habitat occurs in patches ranging from less than 10 to several hundred acres. Other areas have a matrix of owl habitat interspersed with numerous clearcut patches and other areas that are not suitable habitat. Some relatively large blocks of contiguous habitat occur in Wilderness Areas and sites not yet entered for logging.

Management direction—A strategy to establish a network of SOHAs, similar to that of the Pacific Northwest Region, was adopted. The direction to do so was included in Regional Standards and Guidelines, Land Management Planning Direction, Pacific Southwest Region, FS, 15 January 1984. This document provided direction to the Forests to select and delineate SOHAs, but it allowed flexibility for change in their locations and boundaries until final land management plans for each Forest could be completed.

A total of 278 SOHAs was designated on the four owl Forests. Unlike in the Pacific Northwest Region, this number included SOHAs that were totally in Wilderness Areas. Each SOHA was to provide 1000 acres of suitable spotted owl habitat. If 1000 acres did not exist, additional acreages that would grow into suitable habitat were added to bring the total up to 1000. A 25% overlap with another SOHA was allowed. For example, 1750 acres of suitable habitat would be sufficient for two pairs.

In California, SOHAs were also required to have replacement habitat. Forests were allowed the option to dedicate the SOHA (which means no logging activities would be allowed) or to select either uneven-aged or even-aged management. The amount of replacement habitat varies with the selected option. For dedicated SOHAs, 650 acres were prescribed; for uneven-aged management, 1000 acres; and for even-aged management, 1650 acres. Logging activities were allowed only on acres in excess of the 1000 to be maintained as suitable at all times. The replacement habitat does not necessarily need to be currently suitable, but it must have the potential to become suitable. Figure CS is a schematic of a SOHA in California.

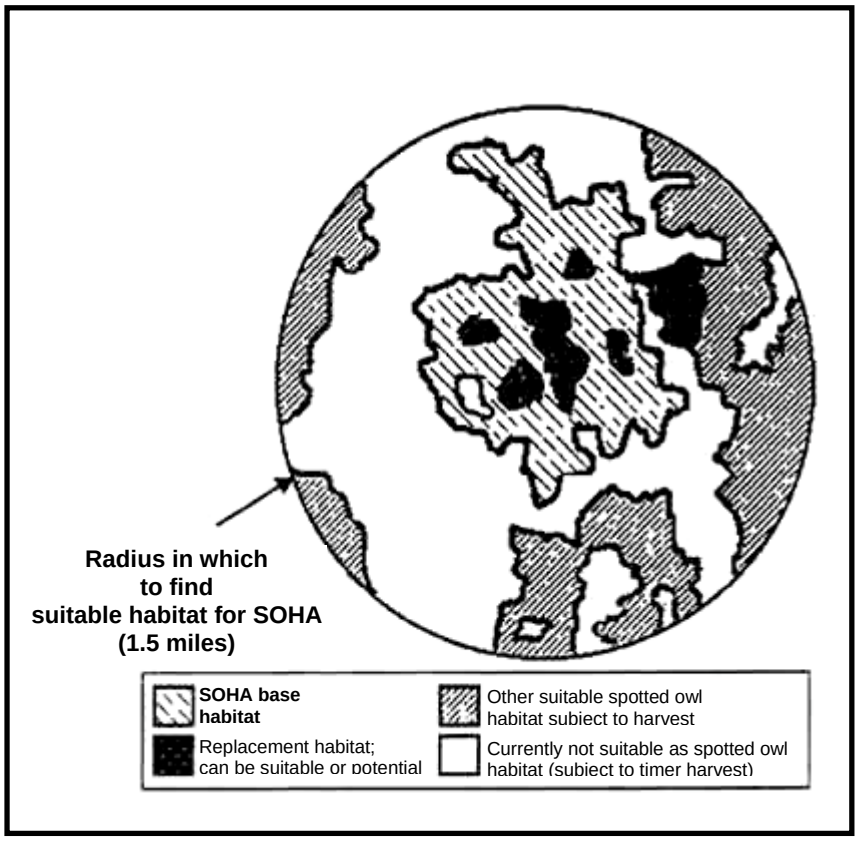

Figure C5—Schematic of a spotted owl habitat area (SOHA) on National Forests in California.

The spotted owl network system in northwestern California—which includes SOHAs, other suitable habitat in Wilderness Areas, and lands unsuited for timber production outside SOHAs—totals 553,700 acres (USDA 1989). This area is about 12% of the total forested acreage and about 66% of the remaining owl habitat. About 65% of this habitat occurs in Wilderness Areas and on lands not suited for timber production. Distribution of habitat in Wilderness Areas, although not totally contiguous, appears to comprise fairly large areas capable of supporting multiple pairs.

Standardized surveys for owls in areas of proposed timber sales were initiated in 1989. The standards are nearly identical to those used in the Pacific Northwest Region described earlier. A detailed description is included in the FS Report to the FWS (USDA 1989).

No comprehensive, consistent management direction for pairs outside the network exists in the Region. Spotted owls found in or adjacent to areas to be logged are evaluated case by case. Generally, logging in areas where a nesting pair occurs is deferred until after the nesting season. A small area (5 to 30 acres) around the nest site or center of activity is often given long-term protection.

Appendix C: Current Situation

Information supplied to us by the National Forests indicates that owl habitat on those lands is expected to decrease about 0.8 to 1.0% per year for the next decade. Dispersion of the harvest units will continue to cause habitat patches to become smaller and more widely separated. The effects of this fragmentation are described in the section for the Pacific Northwest Region and in greater detail in appendices N and O. Because forest stands that are not currently suitable habitat are included in the SOHAs some increases in habitat are expected in future decades.

As in the Pacific Northwest Region, the population of owls in National Forests is expected to decline as suitable habitat declines and becomes more fragmented. The Pacific Southwest Region has not estimated rates of population decline or expected occupancy rates of its SOHAs.

The monitoring and inventory program goals and objectives for the Pacific Southwest Region have been described under the section for the Pacific Northwest Region. In addition to activities described in that section, inventories to determine owl occupancy of SOHAs not monitored in the 5 years before 1989 were done on Forests in California. Detailed results of the monitoring and inventory programs for the Pacific Southwest Region are available from the Regional Office in San Francisco and are also compiled in the FS report to the FWS (USDA 1989).

Monitoring—Comparisons of the RSAs survey results from 1988 and 1989 indicate slight decreases in owl occurrence for all categories: pairs, reproductive pairs, and single birds (USDA 1989). Confidence intervals for the 2 years of data are large, so results are inconclusive. As in the Pacific Northwest Region, a positive relation was found between amounts of suitable habitat in the RSAs and occupancy by owls (USDA 1989).

Data from SOHA monitoring for 1989 (USDA 1989) indicated that 95% of the SOHAs had at least one spotted owl, 58% had pairs, and 23% had reproductive pairs. Combined data for 1988 and 1989 showed 97% of the SOHAs with at least one owl, 78% with pairs, and 55% with reproductive pairs.

Inventory—To determine current occupancy, SOHAs that had not been visited 1984 were inventoried (USDA 1989); 23 were in Wilderness Areas, where no reproductive pairs were found. Results are included in 10-year cumulative totals that include owls detected from surveys of timber-sale areas, inventories, and monitoring. As in the Pacific Northwest Region, all of these efforts—especially surveys of timber sales—resulted in finding new sites where owls were located, or upgrading a site from a single bird to a pair or reproductive pair. How these cumulative totals are related to actual populations is difficult to determine. Pairs reported in table C1 are based on data supplied by Forests from the last 5 years. These figures probably represent the number of sites that can still support spotted owls more closely than do the 10-year totals.

Assessment of current management—The management strategy for spotted owls and their habitat in the Pacific Southwest Region is similar to that of the Pacific Northwest Region. The SOHAs are designed to provide for the needs of an individual pair of owls. More of an effort has been made to clump SOHAs into groups of two and three in California than was done in Washington and Oregon. This practice is an improvement over single-pair areas; however, acreages of suitable habitat designated for the SOHAs are well below average and median amounts observed in annual home ranges of pairs described in the literature (see appendix I). A cluster of SOHAs with less than the observed average or median acreage is unlikely to sustain multiple pairs through time. Wilderness Areas support multiple pairs of owls, but some parts function as several single-pair areas rather than interacting-pair areas.

About 38% of the SOHAs do not contain 1000 acres of suitable habitat, as defined by the Forests (USDA 1989) (but see appendix F for a discussion of this situation in California). About 70% of the SOHAs on the Mendocino National Forest fall below 1000 acres of suitable habitat. A broader definition of habitat, however, that includes the full range of forested types and conditions now known to be used by spotted owls in California would likely give higher percentages of SOHAs meeting the requirements.

Present options to expand SOHAs are limited in most areas. Only 2 to 6% of the SOHAs could reach 2500 acres of suitable habitat on three of the Forests (USDA 1989). About 20% could be expanded to reach that size on the Six Rivers National Forest. Logging will continue to diminish the amounts of suitable habitat and fragment the remaining patches, further reducing options.

Interviews with personnel on National Forests in California (appendix D) indicate much confusion about timber management in SOHAs. Although some types of management strategies are likely to produce suitable owl habitat, we were not given any management plan that was spatially explicit.

We believe that the current management strategy in the Pacific Southwest Region—managing for a few multiple-pair areas and a series of one- to three-pair areas—combined with factors discussed above, and the implementation problems described in appendix D, result in an unacceptable risk to the owl population (see appendices N, O, and P).

BLM

The BLM administers lands in the geographic range of the spotted owl in all three States, but only BLM lands in Oregon and California are occupied by owls. Because of topographic features, inherent plant community types, and ownership patterns, BLM lands in Washington have no potential to contribute to this conservation strategy.

Management direction—Between 1978 and 1983, the BLM completed seven timber management plans for the 2.4 million acres of land administered by the five western Oregon Districts. Through the Records of Decision for these plans, habitat was provided for 79 pairs of owls under the Oregon Interagency Spotted Owl Management Plan (Oregon Endangered Species Task Force 1977). These guidelines called for habitat areas with at least 300 contiguous acres of old-growth or next-oldest forest to be surrounded by an additional 900 acres managed so as to maintain at least 50% of that area in stands older than 30 years (appendix B).

Appendix C: Current Situation

Under the seven management-plan decisions, only the two plans in the Medford District, completed in 1979 and 1980, specifically protected owls by excluding tree cutting on commercial forest lands. Under the remaining five plans, which were completed in 1983, owl habitat was accommodated through land allocations for other resource management purposes. These allocations included maintaining old-growth forest ecosystems by withdrawing them from the commercial forest land base and using longer cutting rotations that constrained timber harvest on specific areas.

In 1983, the BLM and the Oregon Department of Fish and Wildlife (ODFW) entered into an agreement for managing owl habitat on BLM lands in western Oregon (USDI 1983). This agreement, to be in effect for 5 years, expanded on the recently completed land-use plans by adding an additional 11 management areas, bringing the total to 90. In 1987, the agreement was revised (USDI 1988) and now forms the cornerstone for managing habitat until the 1990 decade Resource Management Plans for BLM lands are completed. A longer term management strategy for the will be spelled out in these plans, which are projected for implementation in 1992. The 1987 agreement established constrained timber-cutting areas (Agreement Areas) around 110 owl locations, distributed across five western Oregon BLM Districts encompassing 230,400 acres, to maintain a distributed population of 90 pairs of owls on BLM lands. The actual number of areas under the BLM-ODFW Agreement is now 109 because lands containing only one area were transferred to the BIA and have not been replaced. This reduced the total area under the Agreement to 228,000 acres. Figure CO provides an example of an Agreement Area.

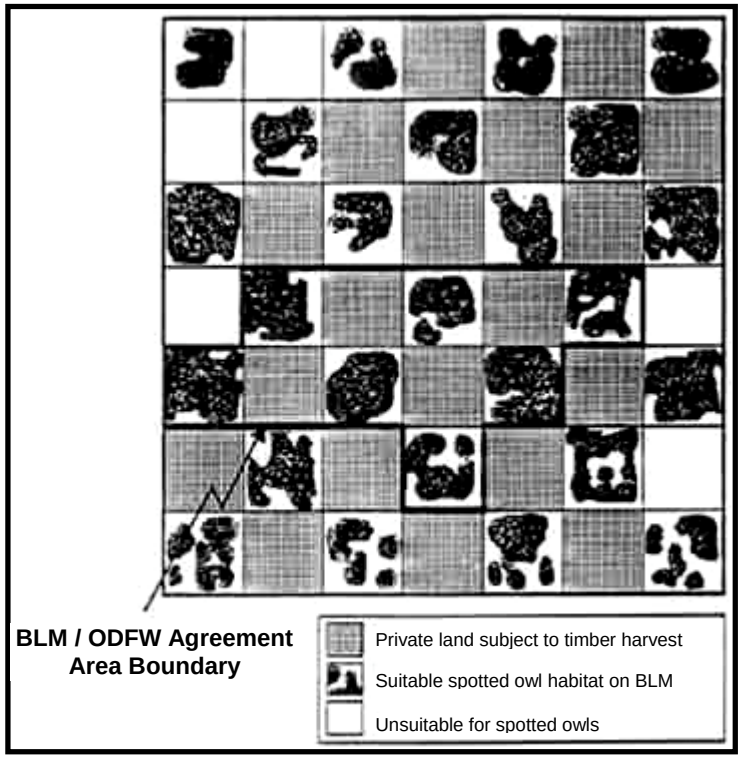

Figure C6—Schematic of a BLM-ODFW Agreement Area. Logging within the boundary is deferred on BLM forested stands over 80 years old.

Appendix C: Current Situation

The individual Agreement Areas were delineated around known locations as determined from inventory and monitoring efforts. Guidelines for developing the areas set a goal of delineating at least 2200 acres (based on Forsman and Meslow 1985) of conifer forest over 80 years old, no farther than 3 miles from the known activity center of a single owl or pair. Exceptions occurred where the acreage of >80-year-old forests did not exist within the 3-mile limit or where the parties agreed to use on-site information on home-range size collected by using radio-telemetry. This strategy sometimes resulted in delineation of more than 2200 acres and sometimes less. Agreement Areas range from 734 to 4188 acres. Average forest acreage >80 years old in Agreement Areas is nearly 2100 acres.

In 1989, an additional 12 habitat areas were established and given 1-year interim protection as a result of instructions to the BLM in Section 318 of the Fiscal Year 1990 Interior Department Appropriations Act. These 12 areas were created under the same guidelines used for the BLM-ODFW Agreement Areas. The added areas bring the total to 121, for which BLM is deferring harvest of selected forest stands. This management course is based on stipulations in the BLM-ODFW Spotted Owl Agreement and language in the Fiscal Year 1990 Interior Appropriations Act.

These 121 habitat areas provide specific protection for about 28% of the known pairs occurring on BLM lands, based on data from 1985 through 1989. Additional pairs and individual, unpaired owls may live within the boundary of a given habitat Agreement Area, but habitat was allocated with the intention of maintaining only one pair in each area under the Agreement, over the long term.

Most owl locations with known pairs occur outside the designated Agreement Areas. Much of the habitat used by these birds is subject to harvest in the timber management plans. Currently, no formal policy deals with this habitat. Consideration is given to planning timber harvest units in a manner that reduces or eliminates the impact on the habitat of these pairs. Every effort is made to defer harvesting of stands containing known nest trees. All of these measures, however, are discretionary to the Resource Area Manager. As a result, efforts to reduce or eliminate impacts on pairs outside of the interim protection areas have met with only partial success because the Area Manager must attain the programmed timber-volume quota.

In California, northern spotted owl habitat is located in the Ukiah District of the BLM. Direction for owl management there is described in an excerpt from USDI (1989b):

> In 1980 the Ukiah District drafted an environmental impact statement (EIS) on timber management which includes spotted owl and managed old-growth forest mitigation. The ‘state-of-the-art’ for spotted owl mitigation at the time was to provide 300 acres for each pair of owls. Ukiah’s EIS called for 300 acres, **or where available more**, for each pair. The reason **or where available more** was added to the 300 acre mitigation is that most of the timber stands in the Arcata and Redding Resource Areas are less than 300 acres in size. Moreover, these tracts are only rarely adjacent to other agency lands.

Appendix C: Current Situation

As a result of Ukiah's Timber EIS and other planning efforts, over 13,000 acres of known and potential spotted owl habitat have been withdrawn from Ukiah's timber base. This 13,000 acres of owl habitat is within 20 different tracts of land. Six of these tracts have been designated Old-growth Forest Research Natural Areas/Areas of Critical Environmental Concern.

Habitat estimates and trends—The amount and distribution of owl habitat on BLM lands in Oregon and California are influenced by natural events and human activities. Among the major factors contributing to the current status of habitat conditions are the scattered or checkerboard ownership pattern: past land-management activities, primarily timber cutting; and natural occurrences, such as forest succession, wildfire, and windstorms.

These factors combine to create a habitat mosaic for spotted owls that is most commonly a patchwork of stands >80 years old, distributed across the landscape in patches ranging most commonly from 50 to 500 acres, occasionally with areas of 2000 to 5000 acres, where ownership is contiguous and the described factors have had less influence. The remainder of the areas are in recent clearcuts or in stands of trees ranging from 5 to 80 years old. In both Oregon and California, most timber cutting has occurred since the end of World War II in 1945.

No intensive, field-based inventory has been done on BLM lands to determine acres of suitable owl habitat. Estimates for the two-State area (table C1) are from interpretations of aerial photos, forestry-based stand descriptions residing in BLM files, and the knowledge of wildlife biologists and foresters with experience on these areas. For the purposes of these estimates, habitat was considered to be forests 80 to 100 years old and older within the area defined by the current distribution of owls, including marginal to superior components of habitat, as described in appendix F.

In Oregon, nearly 82% of the remaining suitable habitat is available for timber cutting under current land-use plans. Assuming that the current average annual cutting rate of 23,400 acres would be applied to the 700,000 acres of habitat available for harvest only about 160,000 acres of currently reserved habitat would remain in 30 years—a decline of over 80% from present conditions. And this decline is just the continuation of a downward trend that began in the 1940s.

The magnitude of the full decline is evident by examining the pattern in the last 20 years. Based on data on forest age-class distribution on Oregon BLM lands, nearly 475,000 acres of suitable habitat have been lost within the past 20 years. If the current trend continues, over 1 million acres of suitable habitat will have been removed from BLM lands in western Oregon over the 50 years from 1968 to 2018. The past and projected trends clearly show that suitable habitat on BLM lands is declining. Opportunities for maintaining suitable habitat on BLM lands have been reduced and will be extremely limited within 30 years. Habitat recruitment on lands where the forest was cut in 1968 is not anticipated to begin until 2048, when the stands cut would reach 80 years of age. Under current cutting schedules, most of

these areas would then be harvested a second time and the recruitment negated. The ownership pattern, with sections of private and public lands alternating in checkerboard fashion, compounds these problems. The private lands are managed on short-rotation schedules, so the checkerboard pattern places an extra burden on the ability of BLM lands to maintain spotted owls.

Spotted owl surveys—Information on spotted owls on BLM lands in western Oregon is a product of inventory and monitoring done at various intensities since the early 1970s. Although surveys have been extensive, not all lands that may support owls have been adequately surveyed, and we have no estimate of the percentage of lands surveyed. Data gathered during the field seasons from 1985 through 1989 provided insight into the number, distribution, and reproductive status of owl pairs on BLM lands (table C1). In addition to the 431 locations where pairs were found in Oregon, about 100 additional locations had individual owls, but the presence of a mate was not determined. Based on past experience, a portion of those individuals are actually pairs.

Survey efforts on BLM lands in California have been less intensive than those in Oregon. Spotted owl locations to date (table C1) have been found because BLM lands were included as part of a larger general survey by Humboldt State University personnel and field surveys by BLM personnel relative to site-specific, proposed resource management actions such as timber sales. Forest lands in wilderness and wilderness study areas have not been inventoried.

Monitoring—Guidance and standard procedures for monitoring owls on lands administered by BLM in western Oregon are contained in USDI (1986). The objectives of the monitoring are to determine, annually, the occupancy rates and reproductive success of spotted owls within the BLM Spotted Owl Management Areas (SOMAs). Three intensities of monitoring are provided. (1) Minimum level is attained when the occupancy and reproductive success of pairs in individual SOMAs in each District have been determined. (2) Mid-level monitoring is satisfied by increasing the number of pairs monitored to include additional nonmanagement pairs. The same methods are used to determine occupancy and reproductive success as specified for the minimum level. In addition, as many as possible of the adult and young owls in each area are banded. (3) High-level monitoring increases the number of sites monitored for occupancy and reproductive success to include all known sites, regardless of management status. As in mid-level monitoring, as many adults and young are banded as possible, and radio-telemetry techniques are used to monitor SOMA pairs to determine actual use of habitat in their home range. Finally, high-level monitoring also calls for implementing research to study responses of the birds to timber management practices. The research should focus on the impacts of vegetation manipulation (primarily harvest of old-growth forest), the occupancy of a site, the home-range size, rates of reproduction, and on the reoccupation of an abandoned site by a subsequent pair.

Appendix C: Current Situation

Presently, all six Districts are monitoring at least at mid-level. Four Districts have initiated investigations under high-level monitoring criteria using radio-telemetry and population studies to explore aspects of home range and response of owls to timber-management practices. Biologists in each District are banding all birds that can be captured, to facilitate accurate counts of individuals, gather demographic information, and determine origins and dispersal distances of juvenile owls.

The monitoring plan for western Oregon BLM lands is silent on how data might be used to assess whether a change in management strategy may be needed. Data are presently being used to track the presence of owls and the number of young fledged in specified SOMAs. Data from 1987 through 1989, on occupancy of areas defined the BLM-ODFW Spotted Owl Agreement, provide an opportunity to compare results with stated objectives—to ensure continued survival of a population of 90 pairs of owls distributed so as to prevent population isolation.

These data indicate that 97 of the 109 areas defined in the BLM-ODFW Spotted Owl Agreement had one pair of owls in at least 1 of the 3 years of survey. Only 83 areas had a pair in at least 2 of the 3 survey years. Based on these values, areas delineated by the agreement are in compliance with meeting the intended purpose of the BLM-ODFW Agreement, although pairs are not present at all sites every year. This variation would be expected, however, because of mortality and movement.

No specific monitoring plan is now in place on BLM lands in California, but additiont surveys are planned as personnel and funding permit.

Assessment of current management—We believe that habitat provided by the BLM-ODFW Spotted Owl Agreement falls short of that needed for a persistent and well-distributed spotted owl population on BLM lands in western Oregon. Because the number of pairs is low, the amount of habitat provided is less than indicated home-range studies in the area (appendix I), and because the habitat provided is widely scattered, individual pairs will become isolated. This isolation will likely lead to low occupancy (50 to 60%) and probably to eventual collapse of the population. We perceive a high probability that the known population of owls on BLM lands will decrease >80% in the next 30 years under current management direction. Remaining pairs will have little, if any, chance of existence as a functional population.

Current management direction for spotted owls on BLM lands in California is outdated. Revision should be based on an updated assessment of habitat capability more complete inventory of owl occurrence. Forested lands in the Ukiah District, particularly in the Arcata Resource Area, provide existing and potential linkages between inland and coastal forests. These lands also have short-term and long-term value for supporting individual pairs, especially when taken together with State and private lands that surround them.

Table C2—Areas (1000s of acres), distribution, and results of spotted owl surveys on NPS lands

State Locality	Total area	Estimated area of owl habitat[a]	Habitat distribution[b]	Owl pairs[c]		Owl inventories[d]
				Known	Estimated	
Washington						
North Cascades	684[e]	126	1	0	20	P
Mount Rainier	235	31	1	8	?	P
Olympic	924	323	1	12[f]	40	P
Oregon						
Crater Lake	183	50	1	4	14	P
Oregon Caves	0.5	0.5	3	1	1	C
California						
Redwood	75	20	2	0	5	U
Point Reyes	54	16	2	2	4	P
Muir Woods	0.5	0.5	3	1	1	C
Whiskeytown	42	4?	?	0	?	U

[a] Generally gross estimates subject to revision except for small areaä.

[b] 1 = Habitat around low-elevation perimeter and separated into blocks by mountains or lakes in the core of the park; 2 = blocks of contiguous low-elevation habitat; 3 = essentially all suitable habitat

[c] Known pairs are those located from 1985 to 1989. Estimates are habitat capability extrapolations, usually from FS or FWS Status Review Supplements.

[d] P = partial surveys with large backcountry areas still unsurveyed; C = complete surveys; and U = unsurveyed lands.

[e] Includes Lake Chelan and Ross Lake National Recreation Areas.

[f] NPS estimates 12 known pairs of spotted owls in Olympic National Park during the last 5 years; WOW tallies 20 pairs. This difference needs to be reconciled.

National Parks

The spotted owl is known to occur in eight NPS areas from the North Cascades to Muir Woods (table C2). The bird may also occupy the Whiskeytown National Recreation Area because it is known to occur in that region of California. National Park areas may contain as much as 570,000 acres of suitable habitat, but these estimates should be regarded as crude first approximations, particularly for the larger parks. Estimates are being refined currently as inventories of old-growth forests are completed.

The configuration and quality of habitat differ markedly among the areas. Habitat in the large, mountain parks of Washington and Oregon (North Cascades, Mount Rainier, Olympic, Crater Lake) occurs in blocks at low elevations around the perimeters of the parks, separated by unsuitable high-elevation areas in the interior. These parks contain spotted owls at the upper elevational limits of their distribution (still poorly defined). Habitat quality may be poor over large areas at higher elevations. Although habitat at Redwood National Park is discontinuous, the federally managed lands are contiguous with habitat in three State parks. Combined, these parks provide about 47,000 acres of contiguous, low-elevation redwood forest habitat. Similarly, the low-elevation habitat at Muir Woods and Point Reyes in California (about 16,500 acres) is contiguous with habitat in a local water-district area and Tomales Bay State Park.

Appendix C: Current Situation

Crude estimates based on "habitat capability" (that is, extrapolations from estimates of home-range size applied to areas of presumed spotted owl habitat) suggest that these NPS units might support &combined total of about 100 pairs of owls, although only about 28 pairs have been documented over the past $ years (table C2). For the larger parks, owl number estimates are little more than educated guesses.

The extent and quality of owl inventories vary among the NPS units (table C2). Generally, extensive areas remain unsurveyed in the backcountry of all the large parks. (Surveying owls in remote wilderness is difficult and dangerous. Such areas are unlikely ever to be surveyed with the intensity and accuracy of lands that contain networks of roads and trails.) Follow-up monitoring of the persistence and reproductive performance of pairs in National Parks is often sporadic to nonexistent, and sometimes depends on the interest of other agencies or groups. The inadequacies of the information on the status of the owl arid its habitat in the National Parks, particularly the Olympic National Park, have presented problems to us in developing the conservation strategy.

Future habitat—About 40,500 acres of additional owl habitat are expected to develop in three National Park areas as forests recover from earlier logging and land clearing. By far the largest amount, 37,000 acres, will occur in Redwood National Park as redwoods are regrown on lands logged about 20 years ago (late 1960s to early 1970s). Based on recent observations of spotted owl occurrence on private forest lands, these cutover redwood forests may support an unknown density of owls in 30 to 50 years (Houston, pers. comm.).

In North Cascades National Park, 900 acres of suitable habitat may develop as western hemlock/Douglas-fir forests grow back after being logged during the 1930s to 1960s. Similarly, 2600 acres of suitable habitat will be regrown at Olympic National Park from a mix of previously logged forests and pastures acquired from 1979 to 1989. About 6000 acres of mixed-conifer forests are being regrown at Whiskeytown on lands that were heavily cutover during the 1950s to early 1970s. Finally, habitat quality at Point Reyes is likely to improve as forests continue to recover from earlier selective logging.

National Park management—Generally, the management objectives for National Parks are considered compatible with maintaining owls (for example, Briggle 1985). Park Service policy states that "Natural resources will be managed with a concern for fundamental ecological processes as well as for individual species and features. Managers and resource specialists will not attempt solely to preserve individual species (except threatened or endangered species) or individual natural processes; rather, they will try to maintain all the components and processes of naturally evolving park ecosystems, including the natural abundance, diversity, and ecological integrity of the plants and animals" (NPS 1988). The emphasis on maintaining ecological processes as opposed to particular biological states may be relevant to managing spotted owls, especially in the large parks. Natural fires are recognized as a force that often drives processes of plant succession, and thus they are to be perpetuated in the parks (NPS 1988). Historically, fires in the parks containing owls ranged frequent, low-intensity, surface fires to infrequent, stand-replacing crown fires (for example, Agee, pers. comm., in press; Henderson et al. 1989). The effects of surface

fires on spotted owl habitat are poorly understood; crown fires, however, clearly reduce habitat. The amount of suitable habitat in National Parks can thus be expected to vary over time, to the extent that natural disturbance forces are allowed to operate. Over long periods, maintaining mosaics of different-aged forest communities in parks (which differ in fuel loading and susceptibility to burning) may be an important means of reducing the probability of catastrophic large fires (for example, Romme and Despain 1989).

Policies of the Pacific Northwest Region of the NPS state: "Since single species management is inconsistent with National Park Service management policies, The National Park Service will not designate formal Spotted Owl Management Areas (SOMAs). This should not be construed to mean that the spotted owls within parks are not to be considered in a larger regional planning effort. On the contrary, The National Park Service fully expects that any regional planning effort will incorporate spotted owl data for the park and address the National Park Service's shared concern for long-term preservation of the species" (Briggle 1985).

Management Issues and concerns—Population theory suggests that the numbers of owls in National Parks are too small for the species to persist over time, if isolated from birds in surrounding areas because of habitat fragmentation (see appendices M and N). Considerations of physiography and size of the parks in the Pacific Northwest suggest that survival of the birds in these areas is closely tied to the welfare of birds on surrounding lands. Each park contains owls at the upper elevational limit of their distribution, and the Washington parks—especially North Cascades and Olympic—approach the species' northern geographic-range limits. Spotted owls that exist under such biogeographic constraints may be particularly susceptible to wide fluctuations in abundance over time, with correspondingly increasing probabilities of extinction. Spotted owl, populations on the Olympic Peninsula, including Olympic National Park, already appear to be isolated from other populations and are thought to be especially vulnerable. Biologists are also concerned that a small subset of owls along the coastal strip of Olympic National Park may be additionally isolated from birds occupying the core of the Peninsula.

Although the numbers of owls in parks appear to be too small for them to persist over time if isolated, they sometimes appear to provide key links in the geographic distribution of the species, and may be particularly valuable in contributing to viable populations in some physiographic provinces.

To help remedy this situation, landscape connectors of suitable habitat should be provided outside of the parks to prevent isolation (demographic and genetic) of the owls inside them. Such dispersal habitat appears to be particularly important now on the Olympic Peninsula. In addition, land management allocations and management activities on lands adjacent to the parks should be done with care to help assure the effectiveness of the National Park areas as reserves for the owls. For example, the edges of all clearcuts that abut parks might be "feathered" to reduce unnatural rates of forest blowdown.

Appendix C: Current Situation

The amount, distribution, and quality of habitat need to be carefully inventoried in the large parks. This information should be incorporated into a park-based geographic information system (GIS) that is-compatible with systems on adjacent lands, to be effective in tracking changes over time.

Inventory and monitoring of owls should be increased in the larger parks, recognizing the difficulties encountered in the large wilderness settings. Some rate of monitoring over time seems necessary to help evaluate the effectiveness of the interagency servation strategy for the owl. An adequate and dedicated inventory and monitoring budget for each large park is needed to accomplish these objectives.

National Parks appear to have been underused as research sites for spotted owls. By virtue of their land-use objectives, these parks may represent important "control areas" for conducting long-term studies of the birds in unfragmented or "naturally" fragmented habitats. For example, large blocks of cutover forest added to Redwood National Park in 1978 offer a unique research opportunity. Although owls are known to occupy second-growth redwood forests 50 to 60 years after logging, the age at which stands are first successfully reoccupied by the birds is poorly known. Permanent survey transects could be established in the park to determine when owls first colonize and reproduce in these changing forests. Such studies would require banding and perhaps radio-marking of park birds.

State of Washington

Washington Department of Natural Resources (WDNR)—The WDNR manages about 1,833,000 acres of State forest lands, primarily to produce funds for public school construction. Spotted owls are known to occur in 24 separate locations on WDNR lands (WDW 1990). In addition, about 180 owl sites are known to occur within 2.5 miles of WDNR-managed land (WDW 1990).

Most spotted owls known to be on these lands are on the Olympic Peninsula. A block of WDNR-managed land, bordered to the north by the Hoh River and to the south by the Clearwater River, has been intensively surveyed for owls (Anthony and Cummins 1989). Eight pairs have been located in the Hoh-Clearwater Block. In the absence of legislative requirements for protective measures for the owl, guidelines for timber-sale impacts on the birds are developed by the WDNR staff case by case. These guidelines have allowed logging within a half mile of spotted owl nest sites and activity centers, which is likely only to delay logging of the sites and eventually eliminate spotted owls on WDNR lands in the area.

In 1988, Public Lands Commissioner Brian Boyle established a Commission on Old Growth Alternatives for Washington's Forest Trust Lands. The Commission was concerned exclusively with old-growth forest on the northwest corner of the Olympic Peninsula. The Commission's recommendations were to defer from harvest 15,000 acres of old-growth forest for 15 years. These areas were selected to provide habitat for four pairs of owls in the Hoh-Clearwater for 15 years. The Commission also recommended alternative silvicultural practices designed to retain some ecological characteristics of old-growth forests in timber harvest areas on WDNR-managed lands the northwest portion of the Peninsula. This plan, though it preserves options and provides for research, allows for logging at the end of the 15-year period.

Appendix C: Current Situation

Washington Department of Wildlife (WDW)—The WDW manages several large wildlife areas adjacent to the Wenatchee National Forest that could provide suitable habitat (Becksted, pers. comm.). About 5000 to 10,000 acres in the Colockum Wildlife Area may be suitable for owls within the next 30 years. Over 20,000 acres in the L.T. Murray Wildlife Area could be suitable within 100 years. Long-term management goals on WDW lands will be to manage more than 50% of forest lands to produce old-growth characteristics. No spotted owls are currently known to exist on or near WDW lands.

Washington State Parks—Washington State Parks manages several widely scattered, forested parcels within the known distribution of the owl. No standing timber over 10 inches in d.b.h. is harvested unless conflicts occur with roads, trails, or campground facilities (Ramsey, pers. comm.). Of particular importance to spotted owls are Beacon Rock State Park (4500 acres), located along the Columbia River near Stevenson; Lake Easton (200 acres) and Olale (350 acres) State Parks, located along Interstate 90 in the central Cascade Range; Federation Forest State Park (600 acres of old growth), located along the White River near Enumclaw; and Rockport State Park (500 acres of old growth), located along the Skagit River in the North Cascades. These State parks may provide important linkages and travel corridors for owls.

Indian tribal lands—Significant areas of suitable habitat occur on the Quinault and Yakima Indian Reservations in Washington State. The Quinault Indian Nation has about 4000 acres of older forest west of Lake Quinault, recently acquired from the Olympic National Forest. Two spotted owls were located on this parcel in 1989 (James, pers. comm.). The Yakima Indian Nation manages 123,000 acres of forest land in reserve management status, about half of which may be suitable for owls (Hansen, pers. comm.). Five pairs and four single owls are known within the reservation. These owls are primarily within designated primitive areas near Mount Adams.

U.S. Fish and Wildlife Service (FWS)—The FWS has two refuges in Washington that presently contain owl habitat. Willapa National Wildlife Refuge, on Long island along the southern coast, contains about 5000 acres of coniferous forest, including a 274-acre old-growth reserve natural area that previously contained a pair. Those birds disappeared about 3 years ago and have been replaced by a pair of barred owls. Annual surveys have not since indicated any spotted owls in the area. Most of the 5000 acres outside of the reserve are now available for timber production because of an agreement tied to its acquisition. Timber harvesting can be curtailed, however, if owls are observed in the area.

The FWS also has about 1500 acres 01 coniferous forest on the Conboy Lake National Wildlife Refuge on the eastern side of the Gifford Pinchot National Forest. No owls have been observed on the Refuge, although they have been heard in the vicinity, and no timber production is permitted.

Appendix C: Current Situation

City of Seattle—The Seattle Water Department currently manages about 68,000 acres of forest land in the Cedar River Watershed near North Bend (Erckman, pers. comm.). About 3000 acres remain in old-growth, with 1500 acres below 4200 feet in elevation. Current management provides for the preservation of all existing old-growth forest; in addition, 50 to 65% (about 40,000 acres) of second-growth forest will be managed as a permanent reserve. Three single owls and one pair have been located in intermingled FS and City of Seattle lands within the watershed.

Private lands—Few spotted owls are known to inhabit private timber lands in Washington. Two or three pairs have been located in a large area bordering the Columbia River, which extends northward to the Olympic National Forest, and eastward to the Gifford Pinchot National Forest (Hays et al. 1989, Irwin et al. 1989a) (see appendix G). Two pairs were located on private lands on the Olympic Peninsula, and seven pairs are known to occur along the eastern Cascades (WDW 1990). As many as 20 pairs are estimated to occur on private lands in Washington (Irwin, pers. comm.).

Fort Lewis Military Reservation—South of Tacoma, the Fort Lewis Military Reservation includes about 68,000 acres of contiguous forest, generally between 50 and 70 years old. Current plans are for intensive, uneven-aged management on 40,000 to 45,000 acres. Some lands will be left in natural condition, but no estimate of acreage is currently available. The nearest known spotted owl pair is located about 15 miles southeast of the reservation on the Gifford Pinchot National Forest. Spotted owl surveys to date have been done in older stands along the Nisqually River, but most of the military reservation has not been surveyed.

State of Oregon

Oregon Department of Fish and Wildlife (ODFW)—The ODFW manages two partially forested properties in the range of the owl, one on the south coast adjacent to Eel Lake (619 acres), and a larger area on the eastern slope of Mount Hood as the White River Management Area. The area is about 30,000 acres, of which about 8600 acres are in mixed conifer-pine-oak woodlands. in addition, about 6000 acres of primarily oak woodland are scattered throughout the area. An existing timber management plan for Eel Lake allows timber harvest to generate funds for wildlife management programs throughout the State. Timber is second-growth, even-aged, and generally about 50 years old. The White River Management Area has received some small harvest units in the past, but no additional logging will occur until a forest management plan is completed in 1990. The forest has a mean age of 60 to 70 years with scattered older trees throughout (130 to 160 years). The area is currently managed primarily as deer and elk winter range. Neither area has been surveyed for owls, but surveys are planned for 1990. Few owls are expected, given the ages and sizes of these areas.

Appendix C: Current Situation

Oregon State Board of Forestry and State Land Board—The Oregon Department of Forestry (ODF) manages 786,000 acres of forest lands in Oregon—654,000 acres under its own jurisdiction and 132,000 acres managed by the Division of State Lands (Jones 1988). The Division also manages the South Slough Sanctuary near Coos Bay, which includes a 3800-acre block of upland forest. Most ODF lands are in western Oregon, but one major block—known as Sun Pass Forest—is on the east slopes of the Cascades. The Department manages about 625,000 acres of their own forest lands within the range of the owl and also about another 120,000 acres of State Land Board lands (Gedney et al. 1989: ODF 1984, 1987,1989). In western Oregon, 25,000 acres of the State Forest land base is reserved for purposes other than timber management, such as watershed protection, fish and wildlife habitat, and administrative purposes. These reserved areas are scattered throughout State Forest lands, generally in small patches or corridors.

The ODF has logged an average of 4600 acres per year for the last 10 years (ODF 1989). Currently, 12% of the forests on these State lands in westem Oregon are more than 80 years old; 74% of the forests are less than 50 years old (Jones 1988). With a planned average rotation age of 70 years, all forests over 80 years old could be harvested in about 17 years. The South Slough Sanctuary block is less than 50 years old and has been logged from one to three times. The Sanctuary area will be managed as a reserve in the future. The Elliott State Forest has the best potential for occupied owl habitat. It contains about 50,000 acres with trees ranging from 80 to 120 years old, with scattered old growth. Sun Pass Forest is managed primarily as an uneven-aged forest and may provide some suitable habitat.

Spotted owl surveys on State Forest lands have been limited to random surveys in the Clatsop and Tillamook Forests by Forsman (1988) and Forsman et al. (1977), and to partial surveys in recent years in Elliot and Santiam State Forests (ODFW, unpubl. data). Responses from owl pairs have been obtained from three locations in these areas. Spotted owls located to date have been associated primarily with mature and old-growth forests. Based on the Forsman surveys, few additional birds are expected in the Clatsop and Tillamook Forests because stands in those areas are young and homogeneous in structure (see appendix G).

In the central Coast Range, State Forest lands are often intermingled with BLM lands occupied by owls. Spotted owls are assumed to be at least foraging on State lands in some areas. In eastern Oregon, no surveys have been done on Sunpass Forest or on scattered State lands south of Klamath Falls, but spotted owls have been located on National Forest and National Park lands adjacent to Sun Pass Forest.

In summary, probably fewer than 20 pairs will be located on State Forest lands. Most suitable owl habitat more than 80 years old, however, will be harvested in the next 10 to 20 years under current management plans.

State Parks Department—The Oregon State Parks Department manages about 165 parks and waysides in western Oregon, ranging from 1 to 8700 acres and averaging 280. Many areas have some forest land, but only 13 are known to have more than 90 acres (the range is 90 to 2500 acres) of forest more than 80 years old. Forested lands usually are fairly contiguous, but 50% of the mature forest is found in only two parks: Silver Creek Falls and Oswald West.

Appendix C: Current Situation

About 50% of the parks have management plans, and some of them are out of Current direction for forest lands is generally protection, except that individual trees considered safety hazards can be removed. A portion of one coastal park was clear. cut because of extensive winter-storm blowdown. The master plan for Silver Creek Fails calls for thinning 1500 to 2000 acres of young stands to enhance tree growth and stand health (Oregon State Parks and Recreation Division 1982).

Preliminary surveys for owls in State parks began in 1989 by ODFW (1989). One adult was located in Sliver Creek Falls Park and two juveniles were later reported. Spotted owls have been reported on Christmas bird counts near Cape Meares Park. Intensive surveys are planned on selected State park lands by ODFW in 1990.

Although habitats for owls are expected to increase on State park lands in future years, few parks are expected to have enough suitable habitat to maintain pairs in the long term. Because of the wide distribution of park lands, however, some parks could support dispersing birds.

Counties and cities—At least 142,000 acres of forest lands are owned by county and municipal governments in western Oregon (Gedney 1986, 1987; Gedney et al. 1986, 1989; Lettman 1988). These lands are primarily located in 16 of the 19 counties. Land parcels are generally scattered, but some counties have larger blocks of a section or more. Coos County apparently has two of the largest individual blocks of commercial forest, one of 2200 and the other of 11,000 acres. From preliminary information, most county forest lands are generally young to mid-aged but less than 100 years old. Timber management plans usually call for shorter rotations, although municipal watershed plans may call for a combination of reserved and managed forests. Some older timber exists on some lands (for example, the Corvallis watershed).

Based on Statewide figures, at least 35,000 acres of city and municipal forest lands are reserved for various purposes, such as parks and watersheds (Jones 1988). Forest Park in the city of Portland, for example, contains 4300 acres of younger mixed-conifer-hardwood forest. In Federal fiscal years 1987 and 1988, local governments logged the timber on an average of 1800 acres per year (amounting to a 60-year rotation). In addition, 1000 to 3000 acres were partially cut.

County and municipal lands generally have not been surveyed for owls. One pair is known to nest in the Corvallis watershed, where habitat is a mix of mature and old-growth forest.

Indian tribal lands—Three Indian reservations occur within the range of the spotted owl in Oregon. The Grand Ronde, in the western Oregon Coast Range, has 9800 acres of commercial forests in a contiguous block ≤120 years old. This is a fir forest type on a harvest rotation of ≤80 years. The Siletz, also in the Coast Range, has 3600 acres in scattered small parcels ≤120 years old. It, too, is harvested—on a rotation schedule ≤80 years. And Warm Springs Reservation, in the eastern Cascades, has 311,000 acres of commercial forest in a large, contiguous block ranging in age

from young to >120 years. About half of this land is in ponderosa pine, generally unsuitable as owl habitat, and about 60,000 acres are reserved for purposes other than timber production. Harvest rotations are 80 to 120 years in the fir zone on the Warm Springs Reservation.

At least one owl pair occurs on the Grande Ronde Reservation, and birds have been detected on the Warm Springs Reservation. Systematic surveys, however, have not been done on any of the three reservations. Future surveys are being considered on the Siletz and Grande Ronde reservations.

FWS—Two National Wildlife Refuges (NWR) in Oregon now contain owl habitat. Cape Meares NWR has only 138 acres of old growth administered as a Research Natural Area. Although owls have been observed in the area, their regular occurrence on the refuge has riot been confirmed. The FWS is presently acquiring habitat that will be included in the Bear Valley NWR near Worden, along the border with California. This area will contain about 4000 acres of older ponderosa pine, with a mix of other coniferous types. Timber production does not occur in this area, which has never been surveyed for owls.

Private lands—Private lands in western Oregon encompass about 6.2 million acres of forest lands (Gedney 1988), of which about 10% are considered incapable of producing commercial forests. Additional private lands occur along the east side of the Cascades, but published inventories are insufficient to identify those that may be within the range of the spotted owl. We estimate about 100,000 acres of commercial forest lands on the eastside.

Private lands are divided into "forest industry" (usually large-company owners) and "other private," owned by individuals. Forest industries own about 4,046,000 acres of commercial forest lands and other private landowners about 1,858,000 acres.

Based on 1985-86 inventories, 80% of forests on industry lands are ≤50 and 90% are ≤80 years old (Gedney 1988). in fiscal years 1987 and 1988, the forest industry ciearcut an average of 60,000 acres per year and partial-cut 43,000 acres (ODF 1989). Fifty-six percent of other private forest are ≤50 and 89% are ≤80 years old. In the same years, an average of 27,000 acres were clearcut and 65,000 acres were partially cut. Based on the above harvest rates and a known decreasing rotation age, most suitable habitat on lands managed under even-aged methods will be removed in <10 years.

Systematic surveys for owls have not been done on private lands in Oregon, although extensive surveys have occurred in association with Federal and State land surveys and research. Where BLM checkerboard lands occur, ≥50% of adjacent private lands have been surveyed (Lint, pers. comm.). In demographic study areas, such as on the Roseburg District, nearly all private land has been surveyed. About 25 pairs have been located on private lands Statewide in the last 5 years.

Appendix C: Current Situation

Management status—The spotted owl is listed as threatened in Oregon by the Fish and Wildlife Commission. Under Oregon statutes, such a listing requires that protection be given the species on State lands only (not private lands). All State agencies must coordinate with the ODFW when a project or action may affect a listed species. Forest management operations on State and private lands are governed by rules under the Oregon Forest Practices Act. The Act was amended in 1987 and requires that the Board of Forestry adopt rules to protect State-listed species or nest sites of sensitive birds. Interim rules have been adopted that require a written plan to be approved by the State Forester when any forest operation is proposed within 300 feet of a nesting or roosting site of a listed species. We do not know, however, how much or what kind of habitat protection will be given to a pair on State lands. Until specific guidelines are adopted in 1991, however, protection will be handled case by case.

State of California

California Department of Forestry and Fire Protection (CDF)—The CDF manages three State forests, totaling 53,648 acres, in the range of the northern spotted owl. The portion of these lands containing suitable habitat is unknown. The Jackson State Forest is in coastal Mendocino County and contains slightly more than 50,000 acres of redwood forest with some Douglas-fir. The redwood forest is second growth, with about 1000 acres of old growth remaining in scattered parcels of <80 acres. Ponderosa pine covers about 90% of Boggs Mountain State Forest, farther inland in southwestern Lake County. The 160-acre Ellen Pickett State Forest is near Weaverville, in eastern Trinity County.

Spotted owls are known from six sites in the Jackson Forest but have not been reported from the Boggs Mountain or Ellen Pickett Forests. Surveys in 1989 disclosed three pairs and two single birds at five sites in the Jackson Forest. A single individual was located at a sixth site in 1974, but that area has not been checked for owls since then. No spotted owl surveys have been done on the other two Forests. The dry, inland pine-forest type on the Boggs Mountain is not known to regularly support owls.

Both the Jackson and Boggs Mountain Forests have active sale programs and are managed with the intent of providing a sustained yield of saw timber. At the Jackson Forest, both clearcutting and selective-cutting are used. Rotation age is about 80 years, although good growth rates in redwood continue beyond 100 years of age. With an annual out of about 30 million board feet, and a possible extension of the rotation age to more than 100 years, the current quantities of forest in various age groups should remain relatively stable or show an increase in older second-growth forest.

Small educational and recreational facilities exist on both forests, but they do not significantly influence the timber management program. A minor land-exchange program is aimed at consolidating holdings, but no significant changes are planned.

Currently, the CDF has no spotted owl management plan, and no active management is occurring on its forests. The Department is leading a State effort to write a California Habitat Conservation Plan (CHCP) for spotted owls, which would concentrate on management of the owl on private and State lands. We assume such a plan will address owl management on State forests.

Appendix C: Current Situation

If current conditions continue, and the California plan for owls is not implemented, owl numbers will likely fluctuate over time as various, previously cut redwood habitats become suitable. At no time is all land likely to be unsuitable, but suitable habitat may be so fragmented that the population may decline. A longer rotation age for those forests, however, might allow them to support as many as 10 to 14 pairs. At present, no plans are in place to monitor owls on the Jackson Forest or to survey Boggs Mountain.

Department of Fish and Game (CDFG)—The CDFG does not manage any State lands with habitat suitable for the northern spotted owl.

Department of Parks and Recreation (CPR)—The CPR manages 28 park units in the north coast of California that are within the range of the northern spotted owl and contain potential habitat. These units occur in Del Norte, Humboldt, Mendocino, Sonoma, Napa, and Main Counties and total 132,625 acres. About 56,000 acres are suitable habitat (table C1), 88% in old-growth redwood forest types and another 5% in second-growth redwood forest (Schaub, pers. comm.).

The State park units are small, with all but two smaller than 10,000 acres and nine smaller than 1000 acres. Eighty blocks of suitable habitat were identified from the 28 units; stands in these units ranged from 12 to 3361 acres and averaged only 563 acres. Only three units currently contain enough suitable habitat to individually sustain a pair of owls, based on recent radio-telemetry studies of home-range sizes in this region.

Records of spotted owls are verified at 27 sites in 19 units. Two units have unverified records, and owls have been reported near two other units since 1973. In the last 5 years, however, owls were recorded from only 12 different sites (eight pairs and four singles) in nine units (table C1). This estimate is undoubtedly low because extensive recent surveys have been done on only four units. All other units need complete inventories.

State parks are managed for their natural qualities and for recreation. No tree cutting occurs except where necessary for safety, to maintain healthy forests, and to develop recreational facilities. In general, habitat management policy is to maintain the natural qualities of the redwood parks, which serves to maintain old-growth forests and provides long-term benefits for owls.

Management plans for the north coast park units are being developed. Because of limited information about owls within each unit, plans often do not specifically address this species. Management trends will continue to benefit owls as second-growth forests mature and become suitable habitat. We have no current estimate of the amount of habitat expected to become suitable in the future.

Appendix C: Current Situation

We expect the California conservation plan to use State park lands with established spotted owl territories as a basis for the plan on State and private lands in north coastal California. If the California plan is not implemented, then the viability of many State park units south of Humboldt County will depend on forest management practices on private lands. State park units, even in the presence of scattered parcels of suitable habitat on BLM lands, are too small and too widely spaced to individually sustain a viable population of owls.

In preparing management plans for the park units, CPR is conducting biological surveys of each unit. Part of the survey is to determine each unit's suitability for owls, assessing the current number occupying the unit, and delineating the suitable habitat believed to be used by spotted owls. No monitoring of the owl population in park units is planned.

California Lands Commission—Currently, the CDF manages 3836 acres of California Lands Commission property, in 18 parcels throughout the State. Twelve of these small parcels, ranging from 11 to 640 acres, are in the Shasta/Trinity area. The 10-year management agreement between these two agencies expires in mid-1990.

The situation on other Lands Commission parcels is not currently known. We know of no other major blocks of State land not already managed by another State agency in the range of the spotted owl in California. Any remaining small parcels are likely to be scattered "school lands" (the mile-square Sections 16 and 36, granted to the States). Such areas are relatively unimportant to owls in aggregate. These sections may, however, be important to the maintenance or integrity of individual spotted owl management areas, and an inventory of these sites should be done during the preparation of the California plan and reviewed for local importance.

The Nature Conservancy—The Nature Conservancy manages two parcels of land with suitable habitat in the range of the northern spotted owl in California. The Northern California Coast Range Preserve in northern Mendocino County contains about 6500 acres of old-growth Douglas-fir in an 8000-acre tract managed in about equal parts by the Conservancy and the BLM. The second area, the McCloud River Preserve in north-central Shasta County, contains 2300 acres of forests, with about 1600 acres in old-growth Douglas-fir and mixed-conifer stands considered suitable habitat. Habitat in both areas is fairly contiguous along major watercourses.

Three pairs are known from the Northern California Coast Range Preserve, two basically using the Conservancy land and one using BLM land. Pairs have been found at all three known sites in the last 5 years, and two pairs have reproduced during that period. No owls have been found at the McCloud River Preserve.

Management of both areas is to preserve their natural qualities, including the continued maintenance of old-growth Douglas-fir forests. At the Northern California Coast Range Preserve, management of the whole area also depends on the BLM. In the preferred alternative for this area, in the resource-management plan for the Arcata Planning Area, the BLM will continue to manage their land as an Area of Critical Environmental Concern.

The future management of both areas indicates a continued presence of suitable habitat. The Northern California Coast Range Preserve is relatively small and isolated from other big blocks of suitable habitat, however, and it will depend on the California conservation plan to provide other areas of suitable habitat nearby and a population of birds large enough to maintain itself through time. The McCloud River Preserve is adjacent to the Girard HCA, the major population center for spotted owls in the connecting zone between the ranges of the northern and California subspecies. It should continue to be maintained in a state suitable for use by owls.

National Audubon Society—The National Audubon Society manages a 1000-acre tract of second-growth redwood forest in coastal Marin County. The area provides about 600 acres of suitable habitat and maintains one pair (Schwartz, pers. comm.). Management direction is, and should continue to be, to manage the area for its natural values, including the redwood forest. This small area depends on adjacent National Park, State park, and municipal water-district lands to continue to support owls. Management direction on these neighboring lands is generally consistent with maintaining suitable habitat. The area also is within the block of habitat that supports about 24 pairs of owls at the southern terminus of the owl's range.

Private lands—Private timber lands in California usually fall into one of three major categories: industrial lands, large private landholdings, and small private landholdings (TAC and VESTRA 1989). These ownerships manage a total of 8,613,699 acres, or 53% of all forested lands in northwestern California (industrial lands—2,514,583 acres, large private landholdings—210,170 acres, and small private landholdings— 5,888,916 acres). Lands designated primarily for timber production total 6,793,382 acres, of which 2,188,460 acres are industrial lands (TAC and VESTRA 1989). From 10 to 15% of the industrial land base is inoperable for timber harvest because of physiographic considerations, and production is constrained by regulations on an additional 10% of these areas.

Irwin et al. (1989b), using data from Lloyd (1986a, 1986b) and Colclasure et al. (1986), estimated the following as current acreages of small and large saw timber on private lands in the range of the northern spotted owl in California (total = 2,170,000 acres): for stands ranging from 9 to 20.9 inches in d.b.h.—658,000 acres in the northwestern area and 1,163,000 acres in the northern interior area and for stands ≥21 inches in d.b.h.—217,000 acres in the northwestern area and 132,000 acres in the northern interior area.

Of the 1,750,767 acres of industrial timber lands to be "managed" (see TAC and VESTRA figures above: 80% of 2,188,460 acres), the TAC (1989) predicts that 700,307 acres will be in stands old enough to provide suitable habitat at any given time. They assumed that all such habitat is capable of supporting spotted owls, and used rotation ages for coastal areas of 50 to 60 years and inland areas of 80 to 90 years, with suitable habitat being produced in 25 to 35 years and 40 to 45 years in each area, respectively. Although some habitats in these age-classes contain owls, we believe they underestimate the age at which habitats in these areas typically become suitable for most life requisites of spotted owls (for example, Pious 1989: see appendices F and G for a discussion). More investigations of habitat use in the managed forests are warranted.

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Using the same basic process, TAC (1989) predicted that 1,037,671 of 2,599,177 acres of timber-emphasis lands owned by small land owners will be suitable at any given time. We believe this is an optimistic estimate.

An additional 1,844,240 acres not emphasized for timber production is owned by small, private landowners and by industry (TAC 1989). These are lands dominated by hardwoods and not likely to be subject to intensive harvest in the future: TAC estimates that about 1,475,392 acres of these lands should be suitable for owls.

Private industrial forest habitat occurs regularly in larger blocks, aggregated for management purposes. Blocks, however, may be dispersed. Small, private forest lands also form large areas, but their ownership patterns are complex and parcel sizes are small.

A segment of the timber industry in California performed three major surveys and inventory efforts in the last 2 years. Spotted owls were located at 290 sites (Kems 1989, Pious 1989, TAC 1989). Ninety-nine pairs were confirmed, and reproduction was documented at 36 sites. About 10% of all sites found duplicated sites previously known.

In 1989, CDFG surveys found 13 pairs on 20 sites on private lands (Wooster, pers. comm.). An additional 68 records of spotted owls have been reported previously, although only 11 of those were sightings of pairs in the last 5 years (Gould, pers. comm.).

The TAC (1989) believes that substantial suitable habitat is now available and being used by the owls under past and current timber management practices on private lands, without any past attention having been given to habitat requirements of spotted owls. They predict no changes in land management that will decrease the amount of suitable habitat. Part of the reasoning for this philosophy is the relatively small percentage of timber that is clearcut in inland areas, the presence of regulations and physiographic constraints on harvesting timber on more than 80% of the industrial land base, and the additional proportion of the land that will support suitable habitat while attaining full rotation age.

Because a large proportion of the private land base will be subjected to harvest, the quantity and distribution of suitable habitat will vary locally over time. The extent to which future conditions will differ from current conditions depends on the timber market and on land owners' individual philosophies about land management. Decreases in the world timber supply, increased use of wood and wood fiber from new uses on increased human population, changes in company ownership, and the vulnerability of standing timber crops as objects of corporate takeovers can markedly affect future timber harvest rates.

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If current conditions continue, forests in California managed for timber are likely to be more intensively harvested, leading to younger average stand ages, even in forests selectively cut. Higher harvest rates and the need to achieve regrowth will result in reduced canopy closure in selectively cut stands and further fragmentation. The direction appears to be changing, however, and this outlook could be considerably altered by several public and industry measures intended to improve forest conditions. These measures include drafting and implementing the California Habitat Conservation Plan that will focus on spotted owls, initiatives addressing long-term forest planning and cumulative impacts, and an evolutionary development of the California Forest Practices rules by the Board of Forestry. Effects of these measures on industrial and other private forest lands are currently unknown.

Several large timber companies have instituted spotted owl surveys and inventories in the last 2 years. Six companies will continue extensive inventories, extending over the next 2 years. The main objective of most of these inventories is to document that the owls use second-growth and managed forests. Currently, no monitoring is planned, because no long-term management plans have been implemented.

Indian tribal lands-Reservation lands of the Hoopa and Round Valley Tribes contain significant acreages of forest, managed mostly for timber production. Amounts of suitable habitat are unknown, and no information about owl occurrence is available.

Conclusions

Habitat of the northern spotted owl throughout its range is managed by numerous agencies and land owners with diverse land-use objectives. Regulations requiring consideration of the habitat needs of the owl are often nonexistent. The BLM and FS have implemented management plans requiring delineation of areas to be protected for use by owls, but little consistency exists between agencies. Differences exist even between administrative units of the same agency (see appendix D). The result has been the lack of consistent, comprehensive management planning based on the biological requirements of spotted owls. Inventory efforts vary widely—some ownerships have never been surveyed, or if they have, results are unknown. Sometimes data from inventories between agencies are not comparable. Consequently, much confusion exists and opportunities that would increase biological understanding of spotted owls have been lost. Credibility of the involved agencies has also suffered.

We believe that the current situation—that is, the lack of a well-coordinated, biologically based management plan, applied consistently throughout the range of the spotted owls—is unacceptable and contributes to a high risk that spotted owls will be extirpated from significant portions of their range.

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